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DRAFT

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DEPARTMENT OF DEFENSE HUMAN FACTORS ENGINEERING TECHNICAL ADVISORY GROUP

MINUTES OF THE FOURTEENTH MEETING

SAN ANTONIO, TEXAS

7 - 9 MAY 1985

HOSTED BY:
USAF AEROSPACE MEDICAL DIVISION
BROOKS AFB, TEXAS

CHAIR:

MR. PAUL M. LINTON
NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PENNSYLVANIA

DRAFT

MINUTES OF THE FOURTEENTH MEETING OF THE
DEPARTMENT OF DEFENSE
HUMAN FACTORS ENGINEERING
TECHNICAL ADVISORY GROUP

SAN ANTONIO, TEXAS
7-9 May 1985

The fourteenth meeting of the Department of Defense Human Factors Engineering Technical Advisory Group (TAG) was held in San Antonio, Texas from 7-9 May 1985. During the meeting, which was hosted by the Aerospace Medical Division of Brooks Air Force Base, the Controls and Displays; Manned System Modeling; Professional Education, Training, and Career Development; Sustained/Continuous Operations; Technical Society/Industry Committee; Tri-Service Human Factors Standardization Steering Committee; Tri-Service Workload Coordinating Committee; Voice-Interactive Systems; and the User-Computer Interaction subgroups met in scheduled concurrent sessions.

The agenda (Attachment A) for the fourteenth TAG meeting was structured so that administrative matters were interspersed with technical discussions. For ease of reading the Minutes, the administrative and professional/technical discussions have been resequenced as follows below. Also included in these Minutes is a report by the Human Factors Test and Evaluation subgroup.

ATTACHMENTS

A. Meeting Agenda

B. TAG Operating Board

C. TAG Operating Structure

D. TAG Policies

E. TAG Subgroup Information

F. Aerospace Medical Division - View Graphs

G. Human Factors Engineering Guide to System and Equipment Development -- Draft Charter

H. Professional Education, Training and Career Development -- View Graphs

I. Technical Society/Industry Committee -- View Graphs

J. Controls and Displays -- View Graphs

K.1 Human Factors Test and Evaluation -- View Graphs

K.2 Human Factors Test and Evaluation -- Proposed Charter

L.1 Manned System Modeling -- Report and Attendee List

L.2 Army Aircrew/Aircraft Integration Program

M. Sustained/Continuous Operations -- Report, Attendee List, Draft Charter, Briefings

N.1 Tri-Service Human Factors Standardization Steering Committee -- Minutes of 6 November 1984

N.2 Tri-Service Human Factors Standardization Steering Committee -- View Graphs

O.1 Tri-Service Workload Coordinating Committee, Report and Attendee List

O.2 Army Research Institute/Anacapa Sciences, Inc./LHX Mission Analyses and Workload Prediction Models

O.3 Workload Assessment in Submarine Combat Systems

P. User-Computer Interaction -- Report and View Graphs

Q.1 Voice-Interactive Systems -- View Graphs

Q.2 Voice Interactive Systems -- Attendee List

1. EXECUTIVE SUMMARY

The fourteenth meeting of the DOD HFE TAG, hosted by the Air Force Aerospace Medical Division of Brooks Air Force Base, Texas, was held in San Antonio, Texas from 7-9 May 1985. Meeting concurrently with the TAG were the Controls and Displays; Manned System Modeling; Professional Education, Training, and Career Development; Sustained/Continuous Operations; Technical Society/Industry Committee; Tri-Service Human Factors Standardization Steering Committee; Tri-Service Workload Coordinating Committee; Voice-Interactive Systems; and the User-Computer Interaction subgroups.

During the three-day meeting, administrative and technical topics were discussed, a maintenance operation data access system (MODAS) was demonstrated, computer-based tools for cockpit design were described and an overview of the DOD HFE TAG's history was presented.

Other briefings related to strategic and tactical operational concepts for future Army operations and to preliminary results of a voice-interactive system flight test in the TF/A-18. On the final day of the meeting, attendees toured the School of Aerospace Medicine.

Administrative Summary

- The Minutes of the Thirteenth Meeting were approved as distributed.
- The Air Force will chair meetings 15 and 16 with Mr. Cyrus D. Crites of Edwards Air Force Base, California serving as Chair.
- The Army has selected Dr. Michael H. Strub of the Army Research Institute Fort Bliss, Texas Field Unit as DOD HFE TAG Chair Select. Dr. Strub will chair meetings 17 and 18.
- Acting as the Army's Service Representative is Mr. Clarence A. Fry, US Army Human Engineering Laboratory, Aberdeen Proving Ground, Maryland.
- The Naval Personnel Research and Development Center will host the fifteenth meeting in San Diego, California in November 1985.

Committee and SubTAG Summary

Reports were presented by the chairs or representatives of the following subgroups: Controls and Displays; Human Factors Test and Evaluation; Manned System Modeling; Professional Education, Training, and Career Development; Sustained/Continuous Operations; Technical Society/Industry Committee; Tri-Service Human Factors Standardization Steering Committee; Tri-Service Workload Coordinating Committee; Voice-Interaction Systems and User-Computer Interaction.

Announcements

- Plaques of appreciation were presented to Dr. Norman E. Lane and to Dr. Joseph Birt, former chairpersons of the TAG and to Mr. Donald E. Murray, former TAG Coordinator.
- The TAG Operating Board approved the change in status from interest committee to full SubTAG status for the newly-formed Sustained/Continuous Operations group.
- The following subgroups have selected new chairpersons or new chairpersons select:

  -- Controls and Displays. The term of the current chair, Mr. Jeffrey D. Grossman, CINCPACFLT, has been extended for one year.

  -- Human Factors in Logistics. Chair -- Mr. Dale Mahar, Pacific Missile Test Center, Point Mugu, California.

  -- Human Factors Test and Evaluation. Chair Select -- Dr. James C. Geddie, USAHEL Liaison Office, Fort Hood, Texas.

  -- Tri-Service Workload Coordinating Committee. Chair -- Navy TBD.

- The following subgroups have submitted their charters for Executive Committee review:

  -- Sustained/Continuous Operations.

2. INTRODUCTION AND WELCOMING REMARKS

2.1 Call to Order -- Mr. Paul M. Linton, Naval Air Development Center, Warminster, Pennsylvania.

Mr. Linton welcomed the attendees to the fourteenth meeting of the Department of Defense Human Factors Engineering Technical Advisory Group and expressed his appreciation to the Aerospace Medical Division for hosting the meeting.

Mr. Linton also extended the TAG's welcome to Captain Paul R. Chatelier, Office of the Under Secretary of Defense (R&AT), noting the vital role Captain Chatelier played throughout the evolution of the TAG.

2.2 Air Force Aerospace Medical Division Welcome -- Colonel John H. Wolcott, Deputy Commander for Research, Development and Acquisition, Aerospace Medical Division, Air Force Systems Command, Brooks Air Force Base, Texas.

View Graphs -- Attachment F.

According to Colonel Wolcott, AMD is a fairly large Command with two basic area missions: 1) research, development and acquisition and 2) medical operations. A large portion of AMD's mission at Brooks Air Force Base includes the Occupational Environmental Health Laboratory (USAFOEHL) which is heavily involved in industrial restoration efforts, solving the problems raised by previously buried chemicals. This laboratory is the consulting laboratory for the entire Air Force. Also making its home at Brooks Air Force Base is the Air Force's Drug Testing Laboratory (AFDTL). This is the sole drug testing laboratory for the Air Force and processes over 300,000 urine-analyses a year, testing for up to 14 illegal drugs. The Wilford Hall Medical Center at Lackland is also part of AMD. The Center is the largest Air Force medical facility with 93 medical, dental and surgical specialties and subspecialties.

The three laboratories most closely involved in human factors issues are AFHRL, commanded by Colonel Brongo, USAFSAM, commanded by Colonel Moser, and AFAMRL, commanded by Colonel Mohr. The workforce for these three laboratories is approximately 1,300. A separate system acquisition group is directed by Colonel MacNaughton and Brigadier General Doppelt has the responsibility over all these efforts. Under General Doppelt's direction, AMD is utilizing its unique resources to view man as a systems component and to try to understand what man has to do in his environment. Research at AMD covers a broad spectrum with emphasis on bioengineering and technology transition.

Colonel Wolcott reported that AMD is actively involved in the following research areas:

. manpower and force management
. training technology
. logistics technology
. safety (environmental and medical)
. crew protection and survivability, and
. crew systems integration.

Colonel Wolcott reported that AMD needs to concentrate more efforts in the training area and in that of logistics, dealing with how man relates to the methods in which systems are fixed. AMD is working on an integrated-testing capability which allows the isolation of problems through a procedure of computer-diagnosed analysis. AMD is involved in the issue of environmental safety standards, trying to determine acceptable levels for radiation, chemical, and noise hazards. AMD Laboratories are also developing advanced treatment procedures and equipments for casualties and aeromedical evacuations. In addition, AMD utilizes cockpit automation technology concepts in its efforts to provide an integrated design and is involved in improved crew systems integration.

3. ADMINISTRATIVE BUSINESS

3.1 Minutes of the Thirteenth Meeting

The draft Minutes of the thirteenth TAG meeting were approved as distributed.

3.2 Service Caucus Reports

Army Caucus

Dr. Michael H. Strub (ARI FU-Bliss) reported that the three major activities of the group consisted of:

a) the commendation of Lt. Col. Gerald Krueger (WRAIR) for his outstanding efforts in the organization and formation of the Sustained/Continuous Operations subgroup;

b) expression of the need for a high-level letter of endorsement of TAG activities to facilitate travel and to enhance the services' participation in the TAG; and

c) the selection of Dr. Strub as the DOD HFE TAG Chair Select and of Mr. Clarence A. Fry as the interim Army Service Representative.

Navy Caucus

Mr. Paul M. Linton, substituting for the Navy Service Representative CDR Larry M. Dean of the Naval Health Research Center, reported that the group discussed the following items:

a) the selection of Navy TAG members as the Chairs/Chairs Select of the User-Computer Interaction SubTAG [Chair Select -- Dr. John J. O'Hare (ONR)], Human Factors in Logistics [Chair -- Mr. Dale Mahar (PMTC)], and the Tri-Service Workload Coordinating Committee (Chair -- TBD);

b) the recommendation that the Service Representatives be tasked with ensuring service representation at all subgroup meetings; and

c) a recommendation for the timely preparation and distribution of subgroup agendas to enhance subgroup participation.

Air Force Caucus

Items discussed at the meeting, according to Dr. Richard Schiffler (ASD/WPAFB), were:

a) the commendation of Mr. Nathan W. Davis (AFLC/WPAFB) for his efforts in the development of an awareness of human factors in the logistics community and the encouragement of the participation of the logistics focal personnel in TAG activities; and

b) the need to involve all TAG members in the process of making agenda inputs.

Dr. Schiffler also noted that 800-15 (Human Factors Engineering and Management) has been distributed and that new military human factors engineering educational requirements for the 2675 and the 180 career fields have been determined.

3.3 Operating Board Report

Mr. Paul M. Linton announced that the next TAG meeting was scheduled for November 1985 in San Diego, California, hosted by the Naval Personnel Research and Development Center. This meeting and the May 1986 meeting will be chaired by Mr. Cyrus D. Crites, Edwards Air Force Base, California. Meetings 17 and 18 in November 1986 and May 1987 will be chaired by Dr. Michael H. Strub of the Army Research Institute Fort Bliss Field Unit.

3.4 Acknowledgments

Mr. Paul M. Linton, noting that the TAG's "founding fathers" were beginning to retire or to move to other organizations, called upon Captain Paul R. Chatelier to aid the TAG Executive Committee to express its appreciation to Dr. Norman E. Lane and to Dr. Joseph A. Birt for their many contributions during their tenures as TAG Chairs and Service Representatives. Captain Chatelier presented plaques, enscribed with the signatures of TAG members, to them in "... grateful acknowledgment of their dedicated leadership, technical contributions and untiring efforts on behalf of the DOD HFE TAG ..." A similar plaque was presented to Mr. Donald E. Murray in "... grateful recognition of his invaluable contributions to the efficient administration, organization and conduct of the DOD HFE TAG during his tenure as technical session administrator, August 1977 - May 1981." [Dr. Birt's plaque was accepted in abstenia by Dr. Richard Schiffler.]

4. COMMITTEE AND SUBTAG REPORTS

4.1 Committee Reports

4.1.1 Human Factors Engineering Guide to System and Equipment Development -- Dr. Kenneth R. Boff, Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio

Draft Charter -- Attachment G.

[Due to unforeseen circunstances, the HFE-GSED was unable to meet. A meeting is planned in conjunction with the November 1985 TAG meeting in San Diego, California. Agenda inputs for the November meeting are solicited by the HFE-GSED Chair, Dr. Kenneth Boff.]

4.1.2 Professional Education, Training, and Career Development -- Mr. Todd Jones, US Coast Guard, Washington, DC

View Graphs -- Attachment H.

Mr. Jones reported that the subgroup was continuing to study what constitutes a human factors engineering professional. During the tenure of Dr. Joseph A. Birt, a contract was let to Universal Energy Systems, Inc. to investigate this area. A number of methodologies were considered and it was determined to utilize (Dr. Sidney) Fine's Functional Job Analysis approach. Briefly, the method consists of assembling in a workshop environment a small number of practitioners in identifiable subspecialities. A moderator analyst draws from the participants the significant skills, knowledge, tools and tasks of the job. This information is then filtered back to the participants and recycled to the analyst for verification.

To date, three workshops have been held:

Workshop I - HFE Specialists in RDT&E in Military Systems,
Workshop II - HFE Specialists in Consumer/Commercial Systems, and
Workshop III - HFE Specialists in Forensics/Safety.

Mr. Jones noted that the Committee does not feel that it is part of the DOD HFE TAG Charter to deal directly with the issues of licensing and certification. The results of the workshop study and a forthcoming survey will be provided to a number of groups and to the Human Factors Society Subcommittee on Professional Standards. [See TAG-14 Minutes, Attachment G.] Once a HFE occupational data base and "standard" have been developed, competencies of performance will be derived; and in Phase III of the effort, educational, training, and career guidelines will be developed.

4.1.3 Technical Society/Industry Committee -- Dr. Frederick A. Muckler, American Psychological Association/Division 21 Representative, Essex Corporation, San Diego, California

View Graphs -- Attachment I.

Dr. Muckler reported that the TS/I meetings were well-attended, with representatives from the American Association of Engineering Socities, American Institute of Industrial Engineers, Systems Safety Society, Human Factors Society, American Psychological Association, National Security Industrial Association, and the Electronic Industries Association. In addition, there were attendees from National Laboratories and from the services.

The group held extended discussions regarding the structuring and validation procedures of the proposed Tri-Service Human Factors Engineering Lessons Learned data base effort by Test and Evaluation SubTAG member Captain Donald Loose, Hanscom AFB. According to Dr. Muckler the TS/I Committee enthusiastically supports the concept of a Lessons Learned data base and would suggest that Captain Loose also consider the inclusion of "success stories."

In other business, the Committee continued its discussions on the issues of licensing, certification, guidelines for professional behavior, etc. Dr. Muckler cautioned the group regarding some of the legal implications posed by these issues. He also noted that the Americal Psychological Association's present emphasis is in the development of specialty guidelines for professional practice. Some of these specialty guidelines are available in draft form, i.e. Specialty Guidelines for Professional Practice in Industrial Organizational Psychology; and a Specialty Guidelines for Professional Practice in Engineering Psychology effort is currently underway.

In closing, Dr. Muckler indicated that Committee members are continuing their active participation in other SubTAGs and in the preparation of a response to the Joint Logistics Commanders Joint Technical Coordinating Group on Human Factors Engineering/ Human-Machine Interface. The new TS/I Chair is Dr. Mark M. Brauer and the Chair Select is Dr. Julien M. Christensen.

4.2 <u>SubTAG Reports</u>

4.2.1 <u>Controls and Displays (Mr. J. Grossman)</u> -- Mr. Gordon McElroy, Naval Weapons Center, China Lake, California

View Graphs -- Attachment J.

Mr. McElroy reported that the SubTAG is in the process of increasing its membership and its interaction with other SubTAGs. Current plans include a meeting in close coordination with the User-Computer Interaction SubTAG. Details of this meeting, tentatively scheduled for the late summer, will be sent to all members of both SubTAGs. Mr. McElroy also noted that the SubTAG had received a request for inputs regarding requirements and test procedures for display legibility and semi-readability from Mr. James Brindle of the Naval Air Development Center. The group will formulate a formal Tri-Service response to Mr. Brindle's request.

In other SubTAG business, Mr. McElroy agreed to serve as the Controls and Displays ARPANET processor. Questionnaires, similar to those used by the Voice-Interactive Systems SubTAG and the User-Computer Interaction SubTAG, were distributed to SubTAG attendees. Other individuals desiring the Controls and Displays "Roadmaps" should contact Mr. McElroy. In closing, Mr. McElroy reported that the term of the SubTAG Chair had been extended to a two-year term; Mr. Jeffery Grossman has agreed to continue as Chair.

4.2.2 Human Factors Test and Evaluation (CDR W. F. Moroney -- Dr. James Geddie, USA Liaison Office, Fort Hood, Texas

View Graphs -- Attachment K.1.

Charter -- Attachment K.2.

4.2.3 Manned System Modeling -- Dr. Charles C. Jorgensen, NRC Representative, Oak Ridge National Laboratories, Oak Ridge, Tennessee

See Attachment L.1 for the report and attendee list submitted by Dr. Jorgensen.

See Attachment L.2 for related materials.

Dr. Jorgensen noted that the changes in technology affecting implementation of hardware and of future planning have had a great impact on the advanced system modeling area. He reported that these impacts had caused the SubTAG to re-examine the direction simulation is moving. In order to better address the situation, the group is modifying its Charter to reflect these concerns.

Previously, the general area of system modeling was linked more directly to the types of simulation vehicles being used (standardized languages, methodologies, etc.). According to Dr. Jorgensen, it appears that there is a shift not only in the nature of the way the simulation models are being characterized but also in the implementation areas in which the simulation models may be used. Some of these areas include machine intelligence, robotics, bionics, and artificial intelligence (strategy planning, supervisory control). There is a close interrelationship between what is done in simulation modeling in human factors and the types of computer architecture in which the models are implemented. Currently, the models are based on traditional serial-type machines; however, there are new architectures on the horizon. As simulation modeling begins to move toward more biologically-emulating types of systems and attempts to incorporate human functions in those biological emulations, different classes of types of problems to be examined will occur. According to Dr. Jorgensen, it will be necessary to develop new simulation languages to take advantage of the newer architectures.

In other business, subgroup members gave updates on the status of a variety of modeling efforts:

. Paul M. Linton. Chemical Biological Warfare modeling and pretreatment drugs;

. Paul M. Linton. NATO Defence Research Study Group modeling efforts and techniques;

. Walter E. Gilmore. Idaho National Engineering Laboratory exploratory efforts on simulating optimal crew sizes for nuclear power plants;

. LT Dennis K. McBride. Man/machine tradeoffs and task analysis applications of simulation models being used for naval missile systems;

. Dr. Michael H. Strub. Update on the work being accomplished in the Army Models Committee; and

. Dr. John J. O'Hare. Telescience/problems of simulating remote operations on the ground and in space.

Some of the issues raised during SubTAG discussions included:

a) SubTAG electronic bulletin board for more timely information exchange;

b) symbolic environments to enhance model use;

c) the underlying trend toward data-structure controlled simulation versus the more traditional code-driven simulation; and

d) recommendations for the Joint Logistics Commanders Joint Technical Coordinating Group on Human Factors Engineering/Human-Machine Interface.

In closing, Dr. Jorgensen reported that the subgroup has decided to send a letter of tribute to the family of the late Dr. Arthur L. Siegel in acknowledgment of the outstanding contributions Dr. Siegel made to the modeling and simulation fields.

4.2.4 Sustained/Continuous Operations -- Lt. Col. Gerald P. Krueger, Walter Reed Army Institute of Research, Washington, DC

Report, Attendee List and Draft Charter -- Attachment M.

COMMENTS, QUESTIONS AND ANSWERS FOLLOWING THE PRESENTATION

Q. Who approves your research protocols, in terms of the potential danger to human subjects? In some of the cases noted in the literature, there were reports of hallucinatory behavior among the subjects.

A. Yes, there have been many reports of hallucinatory behavior. They are scattered reports, individual differences kinds of things.

The human use review issues are a service pertinent issue with a particular laboratory in mind. Private institutions doing DOD work must go through the same sort of rigorous review cycles as we do in DOD. The Army Surgeon General has a written Army regulation which is the promulgation implementation document for the DOD 5000.1 regulation on the treatment of human subjects in research. That document was drawn by a DOD committee from the health and human services public law that says that <u>all</u> federal government research will follow these guidelines.

The procedure is that the investigator has an inhouse review first. It is then reviewed by some external human use committee. If this latter committee is not satisfied that all of the risks have been covered, it is usually given to a higher-level committee. It would ultimately come to the Office of the Surgeon General.

As a practical matter, the line Army saw that the medical research community had been avoiding the issue of putting people in heat stress situations in chemical-protective clothing. They went to the Army Surgeon General requesting cooperation in planning research to cover this issue.

Q. Are there severe control requirements you have to meet to conduct these studies? And it is something that no academic institution perhaps could match.

A. Yes, there are stringent requirements.

A. There are a number of academic institutions that have requirements as stringent as ours.

C. There is a mechanism in place; it is working very well and in the last two years they have made tremendous inroads in the prevention of accidents, particularly in the Army.

Q. Are there any reports of unforeseen events as a result of these studies?

A. Not of as yet, to the best of my knowledge. There are criteria established for when you remove a subject from the study and I've seen a number of subjects removed, even when they hadn't exceeded the criteria. The environmental physiologists group would graph the skin temperature and the core temperature. When these two cross on a graph, indicating that the skin is not dissipating the heat from the body, the individual would become a heat stress casuality. But they would tend to remove the subject before this would happen. They also set up an arbitrary criterion of the number of heart beats per minute, per unit of time. Typically, they try to use preventive measures like enforced drinking regimens to make sure this does not happen. As a practical matter, however, the subjects often determine their own stress. Last year at Fort Knox in high-humidity, 84 degree temperature, the tank crews all left the experiment well before the criteria were met. Not a one of them was declared to be in a heat-stress-risk condition. In my opinion, we behavioral scientists are missing some elements. It is not physiology that is the only variable. These people left for a myriad of psychological and physiological variables not related directly to heat stress.

C. Since all of the subjects have a right to remove themselves from the experiment at any time, you will see a lot of this type of behavior.

C. We've also found that some of the subjects are so macho and know so little about their own capabilities that we have to remove them.

Q. Do you see a lot of operational changes based on this research?

A. We've largely been ineffective in changing what we do.

C. We are getting into officer education and basic training but sadly, the effect of it is almost zero.

C. It is not macho for a soldier to take a nap and they should be napping in these (Sus Ops) conditions every chance they get.

C. One of the best places to see some innovative ideas is at the National Training Center. Some units are doing very well in implementing countermeasures.

4.2.5 <u>Tri-Service Human Factors Standardization Steering Committee</u> -- Mr. Gerald Chaikin, US Army Missile Command, Redstone Arsenal, Alabama

Minutes of 6 November 1984 -- Attachment N.1.

View Graphs -- Attachment N.2.

Mr. Chaikin gave a brief overview of the group's objectives, scope and composition, noting that there had been 20 in attendance, including representatives of the Human Factors Standardization Program (HFAC) Lead Service Activity and from the Defense Materiel Specifications and Standards Office (DMSSO).

Mr. Chaikin reported on the status of the following projects:

. HFAC 0009. Personnel and Training Tasking Documents and Data Item Descriptions, formal coordination of the report is expected by the end of June 1985. Recommendations from the report have been included, as an Appendix, in the HFAC five-year plan.

. HFAC 0016. MIL-STD-1294A Acoustical Noise in Helicopters, completion date extended from December 1984 to September 1985.

. HFAC 0019 Numeric Keypad Standardization (completion by September 1985) and HFAC 0020 Alphanumeric Keyboard Arrangements (completion by December 1985). The User-Computer Interaction (UCI) SubTAG will examine these when published and will consider acting as the agent for updating. The UCI group has indicated that it is favorably disposed to undertaking the updating of MIL-STD-1472 user-computer interaction materials, perhaps in a stand-alone document.

. HFAC 0024. Human Engineering Guidelines for Management Information Systems, designated DOD-HANDBOOK-761, is to be completed by June 1985. This project originally resulted from a review of the HFSSC and UCI SubTAGs.

. MIL-PRIME Update. Dr. Richard Schiffler described an ambitious schedule of briefings on MIL-PRIME to military and industrial organizations by the Aeronautical Systems Division's (ASD) Support System Engineering Technical Director. Dr. Schiffler also announced the recent publication of MIL-STD-1782 (Display Symbology for Aircraft in MIL-PRIME) and the prospective publication of MIL-PRIMEs on Aircraft Lighting (June 1985) and Aircraft Interior Noise (July 1985). Work on the Human Engineering and User-Computer Interaction MIL-PRIMEs was also covered. The SubTAG has requested a MIL-PRIME briefing at its fall meeting.

. Task Analysis Update. Dr. James Geddie reported on the "offline" effort by the Test and Evaluation SubTAG and the Human Engineering Laboratory (HEL) in structuring material suitable for use as a possible MIL-STD on Task Analysis. HEL has contracted this work to Batelle Laboratories (Columbus) and is orienting it toward Army Test and Evaluation. Dr. Geddie advised that the T&E SubTAG consensus is that the effort is ontrack with a first draft available at the next T&E SubTAG meeting. At present this document is seen as containing four sections: Requirements, Tailoring Guide, Data Item Descriptions and Methodology Guidance. At the appropriate time, the T&E SubTAG will decide if the draft is suitable for the establishment of a formal standardization project.

. Aircrew Station Standardization Panel (ASSP) Update. This Panel met on 27-28 March 1985 and identified MIL-STD's 203, 250, 411 and 850 as requiring updates. In the ASSP update, as reported by Dr. Richard Schiffler, it was also indicated that a MIL-STD-411 working group has been organized. In addition a draft revision of MIL-STD-203 will soon be ready for circulation. Dr. Schiffler also chairs a Nite Vision and Aviation Lighting System committee which is developing a Tri-Service document to be published as a military specification (Navy lead).

In other HFSSC business, the group discussed the possible use of a Ballistic Missile Office (BMO) draft on the subject of Life Support and Biomedical Factors Coverage to extend the coverage in MIL-STD-1472 or as a basis for a stand-alone document. LTC Gerald Krueger agreed to write a letter to the Occupational and Environmental Health Laboratory at the School of Aerospace Medicine requesting comments on their review of the BMO document. LTC Krueger will provide the Tri-Service Technical Group for MIL-STD-1472 with a copy of the BMO draft, redlined to highlight provisions that might be considered for inclusion in MIL-STD-1472.

Also discussed were the results of a Pacific Missile Test Center review of the Maintainability Design Section of MIL-STD-1472C. A proposed revision of this section (paragraph 59) will be sent out for review and copies will be sent to the Tri-Service Technical Group for MIL-STD-1472. [For additional information, contact Mr. Dale Mahar at the Pacific Missile Test Center.]

Mr. Chaikin reported that although the HFSSC had no candidate study or research efforts to submit to the Joint Logistics Commanders Joint Technical Coordinating Group on Human Factors Engineering/Human-Machine Interface at this time, the item will remain on the HFSSC agenda for continuing inputs. In closing, Mr. Chaikin reported that Mr. Peter Angiola of DMSSO and Ms. Helen Boggs HFAC Lead Activity had attended the meeting. Mr. Angiola provided a copy of the January 1985 Defense Standardization and Specification Program Report to Congress. He also made some suggestions regarding the thrust of HFAC standardization reports. Of the 32 standardization areas, approximately a half-dozen were covered by the Technology Standardization Section of the Report; the HFAC area was one of those covered.

4.2.6 Tri-Service Workload Coordinating Committee -- Mr. Tom Metzler, US Army Aviation System Command, St. Louis, Missouri

Report and Attendee List -- Attachment O.1.

Related materials -- Attachments O.2 and O.3.

4.2.7 User-Computer Interaction -- Mr. Larry Peterson, US Army Human Engineering Laboratory, Aberdeen Proving Ground, Maryland

See Attachment P for the report submitted by Mr. Peterson.

4.2.8 Voice-Interactive Systems -- Mr. Clayton Coler, NASA-Ames Research Center, Moffett Field, California

View Graphs and Attendee List -- Attachment Q.

Mr. Coler reported that the voice interests of the SubTAG attendees ranged from benign environments, such as laboratory and C^3 settings, to the severe environments posed by shipboard, tank, fixed/rotary wing aircraft, and space applications. Presentations were made by Mr. Lockwood Reed (AVRADA) and Mr. David Williamson (Crew Systems Development Branch/WPAFB).

Mr. Reed provided the group with an update of the Voice-Interactive Avionics Program describing the work being done in AVRADA's hotbench with a variety of speech recognizers. This effort, combined with speech synthesis efforts, will ultimately be applied in a UH 60 Black Hawk, which will serve as a flying testbed for the technologies they have developed.

Mr. Williamson described the Speckled Trout program which demonstrates a voice-activated multiuser radio management system in a fixed wing jet transport aircraft. Mr. Williamson also gave an overview of an existing ground testing program that is being used to develop a connected-speech data base to be used for the optimalization of systems that are to be flown. In addition, he described the development of a Lotus 1-2-3 software program that utilizes automatic speech recognition evaluation data. This program is capable of providing a variety of data breakdowns such as threshold effects, delta effects and word effects.

In other business the group discussed the revitalization of their Roadmap project (laboratory hardware and software capabilities) and the search for a new home electronics mailbox for voice ARPANET users. Discussion of the new directions voice research is taking resulted in a list of topics to be considered at the fall SubTAG meeting. The group also decided to try to document, informally, some basic user-training and guidance information on specific speech recognition and speech generation systems to aid new users of particular systems. In addition, SubTAG members will document "lessons learned" for the TAG Test and Evaluation community and will attempt to provide general information for program managers on the state-of-the-art in automatic speech recognition and automatic speech generation and where gaps in the technology exist.

5. PROFESSIONAL AND TECHNICAL PRESENTATIONS

5.1 DOD HFE TAG: History and Evolution -- Dr. Norman E. Lane, Past DOD HFE TAG Chair, Essex Corporation, Orlando, Florida

See Attachment R for the briefing submitted by Dr. Lane.

COMMENTS, QUESTIONS AND ANSWERS FOLLOWING THE PRESENTATION

C. During my presentation, I did not highlight all of the people involved in the early development of the TAG. The efforts of Captain Paul Chatelier, probably more than any other single individual, should be noted. The whole TAG concept was Paul's idea originally -- although we mutated it a bit and may have taken it further than he thought that it might and/or should go. There were other people, some who later became involved in the TAG and some who did not, who gave us excellent advice as to how to approach the formation of the TAG ... how to get things done.

Q. Would you share with us some of the informal rules of the organization.

A. One of the understood rules is that you do not use information in any way that will harm the person who gave it to you. Contractors and industrial people attending the TAG do not use information they picked up in discussions without the permission of the individual from whom it was heard. If you and I discuss something or if you want to volunteer information, that is up to you. But, in my judgment, having been invited to participate in the TAG, I cannot utilize that information without the person's consent. Also, I think that it would be unethical to utilize program and personal information, etc. that may have been gleaned during coffee and social functions. That would be bad form and it would not take much of that sort of thing before people stopped talking to you and to each other. Although it is an unwritten rule, it is one that I feel has been fairly well observed.

One of the other informal rules -- civilization veneer -- is that if two or three people are talking and they make no eye contact with you, go somewhere else. There is quite a bit of business being transacted throughout the course of the TAG meeting.

5.2 Army 21 Aviation -- Mr. Clarence Fry, US Army Human Engineering laboratory, Aberdeen Proving Ground, Maryland

See Attachment S for the briefing submitted by Mr. Fry.

5.3 Preliminary Results TF/A-18 Voice-Interactive System Flight Test -- Mr. Gary Loikith, Naval Air Test Center, Patuxent River, Maryland. Mr. Loikith's briefing was presented during a Government only session. Materials relating to this briefing will be distributed, under separate cover, to TAG-14 Government attendees.

5.4 Computer-Based Tools for Cockpit Design -- Mr. Larry Butterbaugh, Air Force Wright Aeronautical Laboratory, Wright-Patterson Air Force Base, Ohio

See Attachment T for the briefing materials submitted by Mr. Butterbaugh.

COMMENTS, QUESTIONS AND ANSWERS FOLLOWING THE PRESENTATION

Q. Do you see any developments away from desktop to something like a 9' x 9' screen?

A. Although there are some graphic systems that have incorporated some of the large plasma panel displays, we were somewhat constrained by our budget. However, the larger the screen you have to design on, the better.

Q. Could you tell us why you selected the package you used for display format design?

A. That basically takes advantage of the inherent intelligent graphics that are in the terminal. We didn't purchase any software to do that. We adapted the programable elements of the graphics mode and used the programable keyboard to assign certain functions to those keys.

Q. Is the system up and running?

A. Yes, the four parts I described are and TAG members are welcome to come to see it.

5.5 Maintenance Operation Data Access System (MODAS), Mr. Chuck Gross, Wright-Patterson Air Force Base, Ohio

View Graphs -- Attachment U.

COMMENTS, QUESTIONS AND ANSWERS FOLLOWING THE PRESENTATION

Q. I noticed that Edwards AFB isn't included. Does that mean that you are not receiving MODAS information from Edwards?

A. Systems Command information does not necessarily get into the MODAS data base unless it is MDC reportable. If it is MDC reportable, it will automatically come in from your base level MDC system.

We accepted the MODAS system in December 1984 and we still have some minor problems with it. It is a large system and at present the staff is small. However, we do have a MODAS Configuration Control Board. It will meet semi-annually and our first meeting was in February 1985.

Q. Do you think that this method of reporting current information will cut down on some of the inflated utilization figures?

A. Yes, and I must caution everyone. We rely, for reporting purposes, on the maintenance technicians on the flight-line and in the shop. They get no benefit out of MDC. In fact, most people will tell you that they don't use MDC.

C. I'd like to address that as well. We have a similar problems using 3-M data. The data is being used to make comparisons between maintenance activities. Basically, you are looking for trends over time. Those data are no more reliable than the individual who made the inputs to begin with. But I found no reason to believe that the inflations were biased one way or another in terms of one maintenance activity or another maintenance-type activity. I found the 3-M data excellent for analytic purposes and the MODAS system could be even better because of the accessibility and currency.

A. I think that is basically true. There is not a bias on any particular working code -- it's random through the system. The system will not give you an exact count but you will get a trend.

C. Some time ago I talked with an individual who thought that the 66-1 data system was going to be the salvation of the Air Force because it could show where more manpower or spares were needed. Consequently, he had his people make truthful reports and as a result his wing turned out to be the "worst" one in the Air Force.

Q. Since prime features of MODAS are its currency and ease of accessibility, is there any concern regarding unauthorized access to the information?

A. If it is to be of value, it has to be available to the people who need it. However, we have tried to address this problem with a user-ID-password system that is well controlled. There is nothing classified in the system and no proprietary information.

[If anyone has additional questions, contact Mr. Frank McGuire or Mr. Gross at AV787-5139/8.]

5.6 Discussion Period

Following the conclusion of the scheduled presentation, Mr. Linton opened the floor for general discussion, comments, and clarification.

a) HFE Lessons Learned Data Base. Dr. James Geddie reiterated that inputs regarding the format, data record layout, lessons learned, etc. should be sent directly to Captain Donald Loose at Hanscom AFB. Captain Loose will coordinate with the Test and Evaluation SubTAG who will, in turn, interact with the Joint Logistics Commanders Joint Technical Coordinating Group on Human Factors Engineering/Human-Machine Interface.

b) HFE Keywords/Thesaurus. Mr. Keith Karn (NATC) expressed an interest in existing keyword lists for use in future projects and to organize existing information. He noted that such a document would aid all subgroup data base efforts and would assist in standardized usage for technical reports. Individuals with lists of this nature or with an interest in developing the HFE Thesaurus/keyword listings, should contact Mr. Karn at AV 356-4157.

c) Proposed Agenda Items.

1) More demonstrations and more time alloted for the demonstrations.

2) More inputs from the user; for example, the tasks and problems of a modern tank commander.

3) A review of the performance measures being used, who is using them, and how these data banks will fit together.

4) Theory underlying human factors engineering.

5) Brief overviews of the concerns of the various services.

6) A presentation detailing the entire systems acquisition process.

7) Interaction between human factors areas and training areas, i.e. human factors and training equipments.

6. CHAIR'S SUMMARY

Mr. Linton exprfessed his appreciation to the Aerospace Medical Division and to Lt. Col. Ralph R. Crow for hosting the meeting and to the School of Aerospace Medicine for providing an excellent tour of their facilities. Mr. Linton also commended the Subgroup chairs for their many contributions to both the subgroup meetings and to the plenary sessions. He made special reference to the thorough job done by Lt. Col. Gerald Krueger in the organization and conduct of the newly-formed Sustained/Continuous Operations SubTAG. Mr. Linton expressed his gratitude to the technical and industrial society representatives for their continuing responsiveness to TAG issues and efforts and their valuable inputs to the subgroup meetings. Note was also made of Ms. Louida Murray's contributions to the organization of the TAG sessions.

In closing, Mr. Linton summarized some of the general accomplishments of the TAG and pledged his support to the new Chair, Mr. Cyrus D. Crites.

ATTACHMENT A

Meeting Agenda

DEPARTMENT OF DEFENSE
HUMAN FACTORS ENGINEERING
TECHNICAL ADVISORY GROUP (TAG)
AGENDA - Fourteenth Meeting

7-9 May 1985
Holiday Inn NW Loop 410, San Antonio, Texas

<u>Monday, May 6</u>

1900 - 2100	Information Room Open (Subgroup agendas, plenary changes, pre-paid registration materials)	1107

<u>Tuesday, May 7</u>

1	0730 - 0825	Technical Society/Industry Breakfast	Dr. Muckler	Holly
2	0730 - 1200	COFFEE and Registration	Ms. Murray	Atrium
	0830 - 1200	HF Standardization Steering	Mr. Chaikin	Holly
	0830 - 1200	Tri-Service Workload	Mr. Metzler	Cottonwood
	0830 - 1200	Manned System Modeling	Dr. Jorgensen	Juniper
3	1200 - 1230	HFE System/Equipment Dev.	Dr. Boff	Holly
	1200 - 1330	LUNCHEON BREAK		
	1330 - 1625	User-Computer Interaction	Mr. Peterson	Juniper
	1330 - 1625	Voice-Interactive Systems	Mr. Coler	Holly
	1330 - 1625	Sustained-Continuous Operations	MAJ Krueger	Cottonwood
	1630 - 1730	Army Caucus	Dr. Strub	Cottonwood
4	1630 - 1730	Navy Caucus	CDR Dean	Juniper
	1630 - 1730	Air Force Caucus	Dr. Schiffler	Holly
	1630 - 1730	NASA Caucus	Dr. Montemerlo	1107
	1830 - 2000	Controls and Displays	Mr. Grossman	Juniper
	1830 - 2000	Professional Education	Mr. Jones	Holly
	2000 - 2100	Operating Board	Mr. Linton	1107

1. Registration materials (badges, receipts) will be available at TS/I meeting in Room A. Coffee and danish will be served during the meeting; moderate fees will be assessed. Reservations are required.

2. Please see coffee break information under "Functions."

3. HFE-GSED meeting will normally be scheduled in Block A (0830 - 1200 hours).

4. During the caucus, the Army will determine the Army Chair Select to chair TAG-17 and TAG-18.

Please note the the Human Factors Test & Evaluation SubTAG is scheduled to meet at the Naval Air Test Center in Patuxent River, Maryland on 30 April and 1 May. For details contact CDR William Moroney (215) 441-2023/AV 441-2023.

Major Gerald Krueger, acting Sustained-Continuous Operations (Sus Ops) Interest Committee, extends an invitation to TAG participants to attend the first formal meeting of the group. In addition to administrative details, the agenda for the May 7 meeting includes:

- o short briefings on current SUS OPS research in DOD laboratories and in Canada
- o formulation of a two-year SUS OPS plan pertaining to the synopsis of existent laboratory and field data and future issues, and
- o future meeting plans.

Wednesday, 8 May -- Magnolia Room

0830 - 0900	COFFEE and Registration	Atrium
0900 - 0905	Call to Order	Mr. Paul Linton
0905 - 0930	Aerospace Medical Division Welcome	Col. John H. Wolcott
0930 - 1030	DOD HFE TAG: History and Status	Dr. Norman Lane
1030 - 1045	COFFEE	Atrium
1045 - 1130	Army 21 Aviation	Mr. Clarence Fry
1130 - 1140	Workload Coordinating Report	Mr. Thomas Metzler
1140 - 1150	Manned System Modeling Report	Dr. Charles Jorgensen
1150 - 1200	Professional Education & Training Report	Mr. Todd Jones
1200 - 1330	LUNCHEON BREAK	
1330 - 1430	Preliminary Results: TS-A-18 Voice-Interactive Systems Flight Test (Government only session)	Mr. Gary Loikith
1330 - 1430	TS/I Meeting	1107
1430 - 1440	Voice-Interactive Systems Report	Mr. Clayton Coler
1440 - 1500	Human Factors Standardization Steering Committee Report	Mr. Gerald Chaikin
1500 - 1515	COFFEE	Atrium
1515 - 1530	Sustained-Continuous Operations Report	Major Gerald Krueger
1530 - 1615		TBD

1615 - 1630	User/Computer Interaction Report	Mr. Larry Peterson
1930	Car Pools Leave Hotel for Dinnercruise (Reservations)	

Thursday, 9 May -- Magnolia Room

0800 - 0830	COFFEE	Atrium
0830 - 0910	Computer-Based Tools for Cockpit Design	Mr. Larry Butterbaugh
0910 - 0920	Controls & Displays	Mr. Gordon McElroy
0920 - 0930	Test and Evaluation Report	Dr. James Geddie
0930 - 1015	Maintenance Operation Data Access System (MODAS)	Mr. Chuck Gross
1015 - 1040	Demo and COFFEE	Atrium
1040 - 1050	Technical Society/Industry Committee Report	Dr. Frederick Muckler
1050 - 1100	Army Report	Dr. Michael Strub
1100 - 1110	Navy Report	CDR Larry Dean
1110 - 1120	Air Force Report	Dr. Richard Schiffler
1120 - 1145	Open Discussion	
1145 - 1200	Chair's Summary	Mr. Paul Linton
1200 - 1330	LUNCHEON BREAK	
1330 - 1530	School of Aerospace Medicine Tour (Reservations)	
1345 - 1700	Executive Board Meeting	1107

ATTACHMENT B

TAG Operating Board

TAG OPERATING BOARD *

Executive Committee

Current Chair (Air Force)
Mr. Cyrus Crites
6520 TESTG-ENAH
Stop 239
Edwards AFB, CA 93523
(805) 277-3334
AV 350-3334

Immediate Past Chair (Navy)
Mr. Paul M. Linton
Code 6021
Naval Air Development Center
Warminster, PA 18974-5000
(215) 441-2561
AV 441-2561

Chair Select (Army)
Dr. Michael H. Strub
P.O. Box 6057
ARI Field Unit
Fort Bliss, TX 79916-0057
(915) 568-4491
AV 978-5297

Army Representative
Mr. Clarence Fry
Director
US Army AMXHE-AD Human Engineering Laborary
Aberdeen Proving Ground, MD 21005-5001
(301) 278-5834
AV 298-5834

Navy Representative
CDR Larry M. Dean
Naval Health Research Center
Executive Officer
P.O. Box 85112
San Diego, CA 92138
(619) 225-2911
AV 933-2911

Air Force Representative
Dr. Richard Schiffler
ASD/ENECH
Wright-Patterson AFB, OH 45433
(513) 255-5597
AV 785-5597

NASA Representative
Dr. Melvin D. Montmerlo
Code RC
NASA Headquarters
Washington, DC 20546
W(202) 453-2743
FTS 453-2743

Ex officio Members

SubTAG Chairs

Controls and Displays
Mr. Jeffrey D. Grossman
CINCPACFLT
Code 02X1
Pearl Harbor, HI 96860
(808) 471-8602

Human Factors in Aviation Screening and Performance Prediction (Aviator Screening)
Dr. Michael G. Sanders
USA Aeromedical Research Division
Ft. Rucker, AL 36362
(205) 255-6862
AV 558-6862

* As of May 30, 1985

Human Factors in Logistics (LOGSTAG)
Mr. Dale Mahar
Pacific Missile Test Center
Code 4025, Bldg. 7020
Pt. Mugu, CA 93042
(805) 989-8981
AV 351-8981

Human Factors Test & Evaluation (T&E)
CDR William F. Moroney
Code 602
Naval Air Development Center
Warminster, PA 18974-5000
(215) 441-2023
AV 441-2023

Manned System Modeling (Modeling)
Mr. James Hartzell
NASA-Ames Research Center
M.S. 239-21
Moffett Field, CA 94035
(415) 694-5743
AV 359-5743

Sustained/Continuous Operations (Sus Ops)
LTC Gerald Krueger
Walter Reed Army Institute of Research (WRAIR)
ATTN: SGRD-UWI-C/Krueger
Washington, DC 20307-5100
(303) 427-5521
AV 291-5521

Tri-Service Human Factors Standardization Steering Committee (HFSSC)
Mr. Gerald Chaikin
Chief, HEL Detachment - MICOM
AMXHE-MI (CHAIKIN)
US Army Missile Command
Redstone Arsenal, AL 35898-7290
(205) 876-2048
AV 746-2048

Tri-Service Workload Coordinating Committee (Workload)
Navy - TBD

User-Computer Interaction (UCI)
Director USAHEL
Bldg. 520
ATTN: AMXHE-CC (Peterson)
Aberdeen Proving Ground, MD 21005
(301) 278-5962
AV 298-5962

Voice-Interactive Systems (Voice)
Mr. Clayton Coler
NASA-Ames Research Center
MS 239-3
Moffett Field, CA 94035
(415) 694-5716

Committee Chairs

Human Factors Engineering Guide to System and Equipment Development (HFE-GSED)
Dr. Kenneth Boff
Aerospace Medical Research Lab.
AFAMRL/HEA
Wright-Patterson AFB, OH 45433
(513) 255-7596
AV 785-7596

Professional Education, Training, and Career Development (PETCD)
Mr. Todd Jones
US Coast Guard
G-DMT/54
2100 Second Street, S.W.
Washington, DC 20593
(202) 426-1058

Technical Society/Industry Committee (TS/I)
Dr. Frederick A. Muckler
Essex Corp.
2135 Hartford St.
San Diego, CA 92110
(619) 276-6905

Liaison Representatives

Coast Guard
Mr. Todd Jones
US Coast Guard
G-DMT/54
2100 Second Street, S.W.
Washington, DC 20593
(202) 426-1058

Federal Aviation Administration
TBD

Joint Logistics Commanders Joint Technical Coordinating Group on Human Factors Engineering/Human-Machine Interface
Dr. James C. Geddie
USAHEL Liaison Office
HQ TCATA
ATTN: AMXHE-FH (Geddie)
Ft. Hood, TX 76544
AV 738-9917/21
Commercial (817) 288-9917/21

OUSDR&E Proponent

CAPT Paul R. Chatelier
OUSDR&E (R&AT)
Room 3D129 Pentagon
Washington, DC 20301
(202) 695-9777
AV 225-9777

TAG Coordinator

Ms. Louida D. Murray
Eagle Technology, Inc.
6714 W. Geddes Ave.
Littleton, CO 80123
(303) 979-7441

ATTACHMENT C

TAG Operating Structure

AMENDED TAG

OPERATING STRUCTURE

From

Minutes of the Eleventh Meeting

FAA Technical Center
Atlantic City, New Jersey

4-6 October 1983

DEPARTMENT OF DEFENSE
HUMAN FACTORS ENGINEERING TECHNICAL ADVISORY GROUP

GOALS

Provide a mechanism for exchange of technical information in the development and application of human factors engineering.

Enhance working-level coordination among Government agencies involved in HFE technology research, development, and application.

Identify human factors engineering technical issues and technology gaps.

Encourage and sponsor in-depth technical interaction, including subgroups as required in selected topical areas.

Assist as required in the preparation and coordination of triservice documents such as Technology Coordinating Papers and Topical Reviews.

SCOPE

Because of the diversity of subject matter covered by the HFE discipline, the scope of technical areas addressed by the Technical Advisory Group (TAG) is necessarily broad. In general, HFE, as defined for purposes of TAG operation, deals with concepts, data, methodologies, and procedures which are relevant to the development, operation, and maintenance of hardware and software systems. Subject matter subsumes all technologies aimed at understanding and defining the capabilities of human operators and maintainers and insuring the integration of the human component into the total system to enhance systems effectiveness. Technologies directed toward improved manpower utilization through selection, classification, and training are included as appropriate.

TOPICAL AREAS

The TAG will address research and technologies designed to impact man-machine system development and operation throughout the complete system life-cycle. The general topics of concern to the TAG include, but are not limited to:

a. Procedures for use by HFE specialists, systems analysts, and design engineers involved in the provision of HFE support during system development or modification.

b. Methodologies oriented toward the identification and solution of operator/maintainer problems related to equipment design, operation, and cost/effectiveness.

c. Mechanisms for application of developed HFE technologies, including formal and informal approaches to validation and implementation, and the determination of time windows for application.

GROUP COMPOSITION

The TAG will consist of technical representatives from Government agencies with research and development responsibility in the topical areas specified above. Additional representatives from activities with allied interests may affiliate with the TAG as appropriate. Attendance at specific meetings may be augmented by technical experts in special topical areas.

OPERATING BOARD

The TAG Operating Board is responsible for the conduct of TAG business and the implementation of TAG policies. The Board consists of an Executive Committee, the chairpersons of all SubTAGs and Committees, and liaison representatives from selected Government agencies. Operating Board meetings are called at the discretion of the TAG Chair.

The Executive Committee will be responsible for providing required continuity and acting for the full TAG between regular meetings. Regular members of the Executive Committee will be:

- Current Chair
- Immediate Past Chair
- Chair Select
- Army Representative
- Navy Representative
- Air Force Representative
- NASA Representative

CONDUCT OF BUSINESS

Meetings of the TAG will be held semi-annually, in the Spring and the Fall. Chairing of the group will rotate annually among the Army, Navy, and the Air Force. The Chair Select will be chosen by a caucus of the service, whose turn it is to chair the DOD HFE TAG. Advice and counsel will be provided by the Operating Board. The Service Representatives will be selected by service caucus at the Spring meetings in even-numbered calendar years. Advice and counsel will be provided by the Operating Board. Minutes of each meeting will be compiled by the Chair. Minutes will be distributed to all participants, to appropriate OSD offices, and to other agreed-upon agencies. Minutes shall serve as the principal mechanism for the reporting of group activity. A file of minutes and relevant correspondence shall be maintained by each Chair. This file shall be passed to the succeeding Chair together with any additions to the file.

TAG SUBGROUPS

The DOD HFE TAG sactions two categories of subgroups: SubTAGs and Committees. Such groups will be sponsored by the TAG as appropriate to respond to needs for more detailed interchange and coordination in specific technical areas. SubTAGs will address problems of a general or continuing nature within a specific field of technology and are to develop their own working charters and operating procedures. SubTAGs may be disestablished upon recommendation of the Executive Committee. Committees will serve at the pleasure of the Operating Board and will address specifically defined tasks or problems. These committees will be disestablished on completion of those tasks or upon recommendation of the Executive Committee. Reports from each subgroup will be published separately and included as a regular item of business on each TAG meeting agenda. Current subgroups are identified in Appendix A.

APPENDIX A

SubTAGs

Controls and Displays

Human Factors in Aviation Screening and Performance Prediction (Aviator Screening)

Human Factors in Logistics (LOGSTAG)

Human Factors Test and Evaluation (T&E)

Manned System Modeling

Tri-Service Human Factors Standardization Steering Committee (HFSSC)

Tri-Service Workload Coordinating Committee (Workload)

User-Computer Interaction (UCI)

Voice Interactive Systems (Voice)

Committees

Human Factors Engineering Guide to System/Equipment Development (HFE-GSED)

Professional Education, Training, and Career Development for Human Factors Engineers

Technical Society/Industry (TS/I)

ATTACHMENT D

TAG Policies

TAG POLICIES

1. Membership (General membership policies are outlined in the Operating Structure, under "Group Composition.")

1.1 Individuals who are not affiliated with Government agencies but are associated with technical societies or industrial associations with a stated interest in human factors engineering are to submit a letter on the organization's letterhead, confirming their status as the organization's representative, to the current chairperson of the Technical Society/Industry Committee.

2. Meeting Sites (Sites are selected by the Executive Committee with a view toward a balance in geographic location, service hosting the meeting, and meeting facilities.)

2.1 Tag members are encouraged to recommend potential meeting sites.

2.2 Organizations who wish to host the TAG should contact their Service Representative or the current TAG Chair.

3. Agenda (The agenda is determined approximately two months before the scheduled meeting. The Executive Committee selects the topics from those recommended by the Service Representatives and the current TAG Chair.)

3.1 TAG members are encouraged to suggest potential agenda topics or topics suitable for tutorial sessions to their Service Representative or to the current TAG Chair.

4. Registration (Registration fees and the date of the close of registration are announced in an information letter sent approximately one month before the scheduled meeting.)

4.1 All attendees are expected to pre-register and prepay by mail.

4.2 Individuals receiving late travel approvals may pre-register by phone by contacting the TAG Coordinator identified in the TAG invitation letter. All payments made at the meeting site are to be in cash.

5. Minutes (The Minutes of each meeting serve as the principal mechanism for the reporting of TAG activities. The Minutes are published as a draft document and distributed to attendees and other selected agencies approximately three months after the meeting.)

5.1 Individuals or agencies desiring to be included on the distribution list for a specific meeting should contact the TAG Coordinator.

5.2 Amendments to the Minutes are to be made to the TAG Chair in writing prior to the succeeding meeting.

5.3 Presentors are expected to submit a copy of their presentations and hardcopies of their visual materials to the TAG Coordinator for inclusion in the Minutes.

6. Subgroups (See the Operating Structure, section entitled "TAG Subgroups," for specific information regarding the purposes and operating procedures of SubTAGs and Committees.)

6.1 All subgroups are strongly encouraged to meet in conjunction with the TAG at least once each calendar year.

6.2 All subgroups meeting in conjunction with the TAG are required to provide a chairperson for the specific subgroup meeting.

6.3 All subgroup chairpersons are encouraged to submit a brief report of each meeting to be included in the set of TAG Minutes covering the subgroup meeting timeframe.

6.4 All subgroups are required to provide the TAG Coordinator with an up-to-date list of their membership, for use in the distribution of TAG announcements.

6.5 All SubTAGs are required to submit to the Executive Committee a Charter including, but not limited to, statements regarding:

- objectives
- scope
- membership policies
- chairperson
- meeting schedule

6.6 Committees are required to submit to the Executive Committee a document including, but not limited to, brief statements regarding:

- objectives
- membership policies
- chairperson

7. Subgroup Establishment

7.1 Groups interested in addressing technical areas not covered by existing subgroups may request the TAG Chair to provide subgroup agenda meeting time.

7.2 Formal subgroups may be established by recommendation of the Executive Committee.

8. <u>Chair/Representative Selection</u> (General selection procedures are outlined in the Operating Structure under "Conduct of Business.")

8.1 A Service caucus may be called by the TAG Chair or the current Service Representative.

8.2 Methods of determining the Chair Select and Service Representatives are Service peculiar.

8.3 Unexpired terms of office will be filled by appointment by the Executive Committee, until a caucus of the Service can be called at the next regularly scheduled meeting.

9. <u>Funding</u> The funding required for the organization, conduct, and documentation of all TAG meetings shall be done jointly be the three services. The specific mechanisms to obtain and allocate funding from services shall be arranged by the Current Chair, Chair Select and Immediate Past Chair.

10. <u>Policy Changes</u>

10.1 Additions to or amendments of the above policies may be recommended by submitting the suggested change(s) in writing to the TAG Chair.

10.2 Policies may be amended by a majority vote of those Operating Board members in attendance at the Operating Board meeting in which amendments have been proposed.

ATTACHMENT E

TAG Subgroup Information

DOD HFE TAG SUBGROUPS

The DOD HFE TAG sanctions two categories of subgroups: SubTAGs and Committees. SubTAGs address problems of a general or continuing nature within a specific field of technology. Committees address specifically defined tasks or problems and are disestablished on completion of those tasks or upon recommendation of the Executive Committee. Additional information governing Subgroups can be found in theOperating Structure and TAG Policies.

Information regarding Subgroup objectives/purpose/scope is contained in the following pages. Please note that this information, taken from the various Subgroup charters, may be in the process of update/revision. For specific details as to the issues currently being addressed by the individual Subgroups, please call the chair.

1. Controls and Displays

Objective: . . . "to assure that the development of advanced display systems for use by human operators is done consistent with the principles of human factors. . . . it is intended to provide a means by which all DOD/NASA personnel who are working in the area of displays can maintain a high level or awareness and currency of developments in displays as they occur."

Origin: TAG ad hoc Committee; August 1978

Current Status: SubTAG

Membership: Open to any DOD/NASA personnel who are working in displays and who participate in the DOD HFE TAG, Representatives of technical and industrial associations as appropriate under TAG policy.

2. Human Factors in Aviation Screening and Performance Prediction

Goals: "Provide a mechanism for the exchange of technical information in the development and application of methods and technologies for the selection of aviation personnel and the prediction of performance of personnel in aviation systems. Enhance working level coordination among government agencies regarding research, development and application of aviation selection and prediction methods and technologies. Identify technology gaps and requirements for advancement in the state-of-knowledge relevant to aviation selection and prediction."

Origin: TAG Interest Committee; March 1983

Current Status: SubTAG

Membership: . . . consistent with policies of DOD HFE TAG.

3. Human Factors Engineering Guide to System/Equipment Design

Purpose: "This committee will define a cooperative interagency program to change and update the 1972 Human Engineering Guide to Equipment Design."

Origin: TAG ad hoc Committee; August 1978

Current Status: TAG Committee

Membership: Tri-Service, NASA, Technical Society/Industry

4. Human Factors in Logistics

Objectives: ". . . a vehicle for the exchange of technical information on human factors related logistics problems and issues that are common to two or more of the services . . . this group might be expected to increase the awareness in both the logistics and human factors communities of problems in the former that can benefit from applications of the latter."

Origin: SubTAG; December 1979

Current Status: SubTAG

Membership: DOD HF related agencies, DOD logistics related agencies, DLA, technical societies.

5. Human Factors Test and Evaluation*

Objectives: " . . . to provide technical assistance in the execution of T&E and to promote coordinated efforts within the DOD and among all government of T&E techniques. . ."

Origin: SubTAG; June 1977

Current Status: SubTAG

Membership: * [Please check with SubTAG Chair for current membership policies.]

6. Manned System Modeling**

Origin: TAG ad hoc Committee; May 1981

Current Status: SubTAG

Membership:

* Charter in process of revision.
** Charter in progress.

7. Professional Education, Training, and Career Development for Human Factors Engineers

Purpose: " . . . to provide an initial liaison between the TAG and the Human Factors Society for the purpose of discussing and recommending undergraduate and graduate level educational programs for human factors professionals."

Origin: TAG Standing Committee; August 1978

Current Status: TAG Committee

Membership: POC's (military and Civil Service), from Army, Navy, Air Force; Coast Guard, NASA, TS/I and other interested DOD HFE TAG members.

8. Technical Society/Industry Committee

Goals: "Maximize and enhance the exchange of human factors information among technical societies, industry associations, and the DOD human factors community. Assist as needed in the preparation, review, coordination, promulgation, and interpretation of human factors documents, specifications, and standards -- military or otherwise."

Origin: TAG ad hoc Committee; August 1978

Current Status: TAG Committee

Membership: " . . . open to technical societies and industry associations within the United States which have a clearly stated interest in the discipline of human factors engineering -- whether set forth in their bylaws or contained in a policy statement."

9. Tri-Service Human Factors Standardization Steering Committee

Purpose: " . . . to provide technical guidance for the planning of the Human Factors Standardization (HFAC) Program and to insure successful coordinated efforts involved in implementing the HFAC Plan."

Origin: SubTAG; August 1977/first meeting December 1978

Current Status: SubTAG

Membership: Chair, one human engineering and life support representative from each service, one personnel and training representative from each service, and selected ex-officio members.

10. Tri-Service Workload Coordinating Committee*

Purpose: The Group was formed to serve as an ad hoc committee in "assessing, guiding and improving the technical investigation among all government agencies involved in operator/crew workload RDT&E ."

Origin: Tri-Service NASA ad hoc Study Group; April 1977

Current Status: SubTAG

Membership: " . . engineering and scientific individuals currently developing and applying methods and techniques for quantifying and specifying operator/crew workload within the Army, Navy, Air Force and NASA."

11. User-Computer Interaction *

Scope: " . . . to address current and potential problems of interfacing users and computers. The users will include the system end users, designers, and the developers/maintainers. The critical feature will be that be 'user' functions 'interactively' with a computer system and its software."

Origin: TAG ad hoc Committee; March 1979

Current Status: SubTAG

Membership: Interested personnel from Government agencies, representatives of technical and industrial associations.

12. Voice-Interactive Systems

Objective: " . . . to assure that the development of voice interactive systems for use by human operators is done consistent with the principles of human factors."

Origin: Interest Committee; December 1977

Current Status: SubTAG

Membership: " . . . open to any interested personnel from government agencies who are working in the speech recognition and speed synthesis area. Representatives of technical and industrial associations as appropriate under TAG policy may also participate.

* Charter in process of revision.

ATTACHMENT F

Aerospace Medical Division - View Graphs

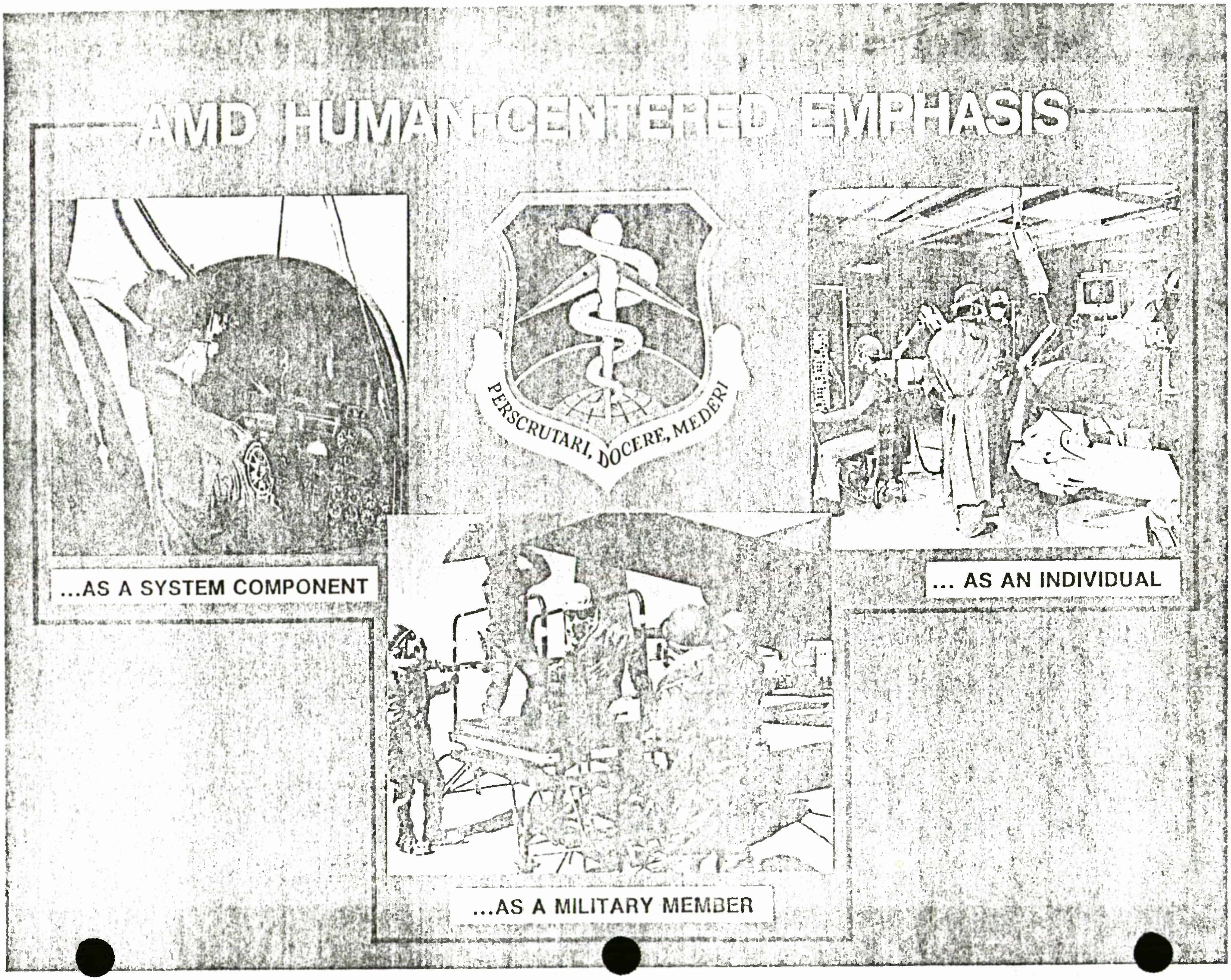
PERSCRUTARI, DOCERE, MEDERI

COLONEL JOHN H. WOLCOTT

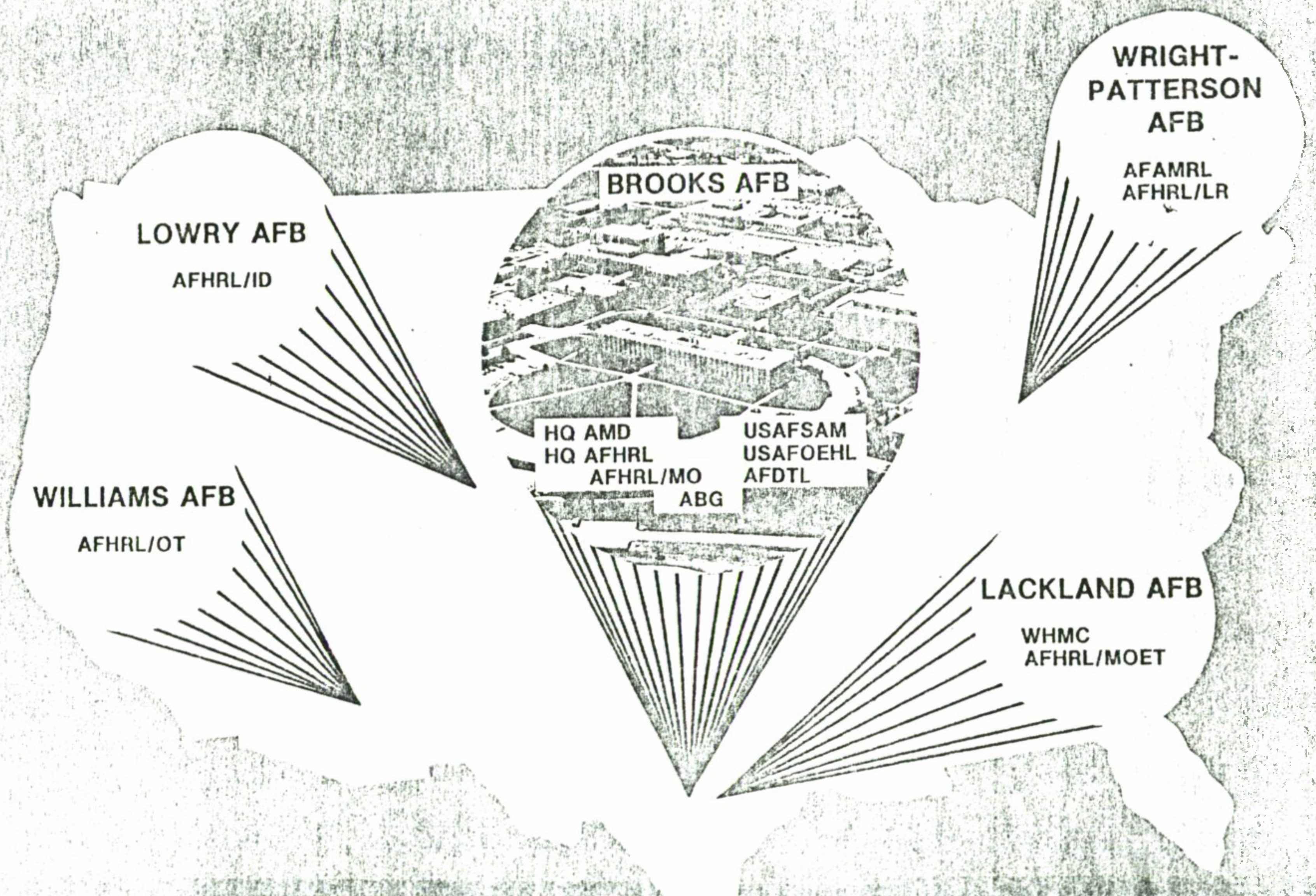
DEPUTY COMMANDER FOR RESEARCH, DEVELOPMENT AND ACQUISITION

AEROSPACE MEDICAL DIVISION

AIR FORCE SYSTEMS COMMAND


AMD HUMAN-CENTERED EMPHASIS
PERSCRUTARI, DOCERE, MEDERI
...AS A SYSTEM COMPONENT
... AS AN INDIVIDUAL
...AS A MILITARY MEMBER

AMD ORGANIZATIONS



AMD S&E PERSONNEL ASSIGNED

EDUCATION

MEDICAL

MD – 38

BIOMEDICAL

PHD – 42
MAS – 25
BAC – 15

BEHAVORIAL SCIENCE

PHD – 50
MAS – 50
BAC – 15

PHYSICAL SCIENCE

PHD – 31
MAS – 49
BAC – 30

ENGINEERS

PHD – 9
MAS – 28
BAC – 58

ACQUISITION

PHD – 2
MAS – 12
BAC – 17

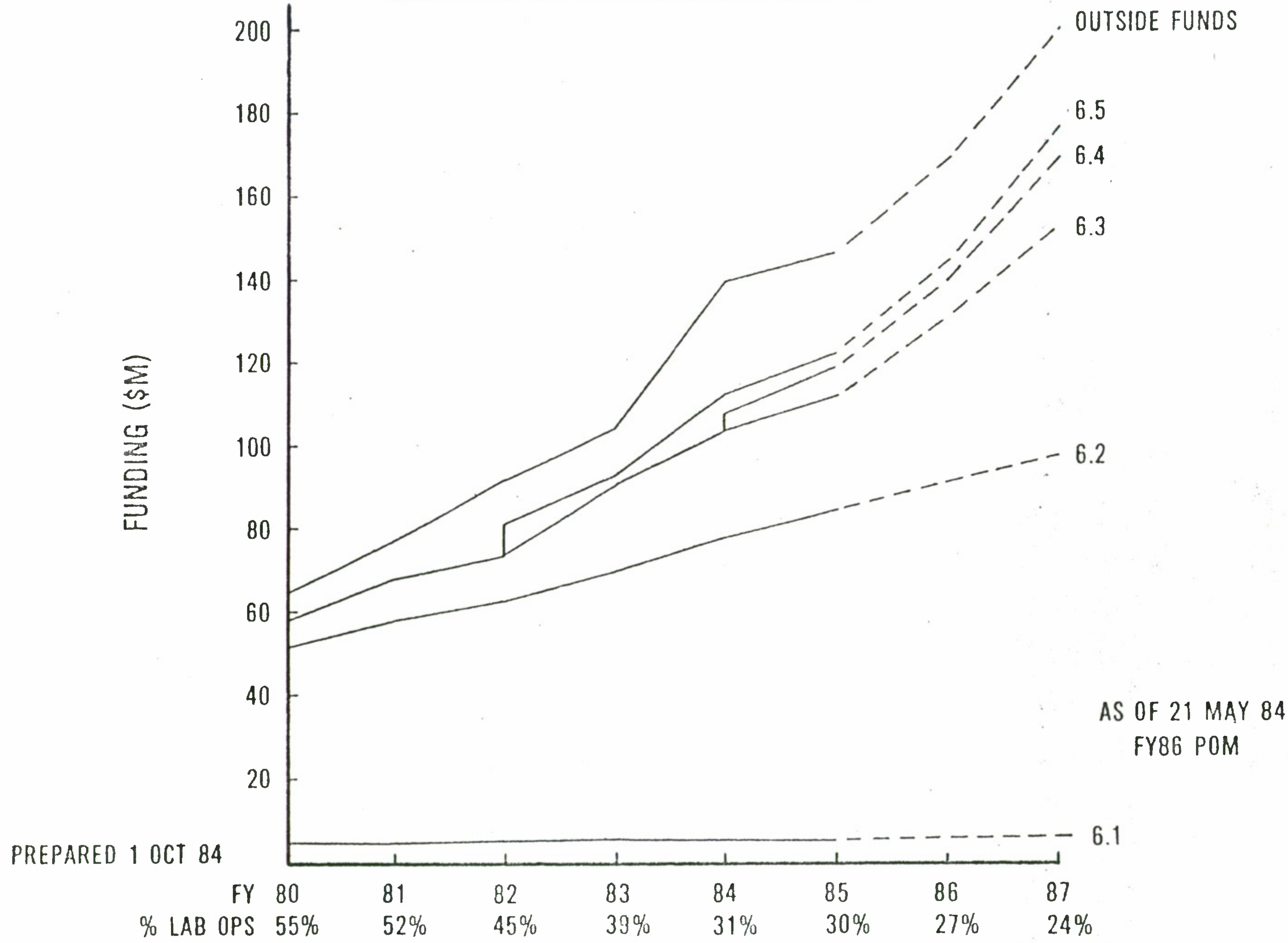
OTHERS

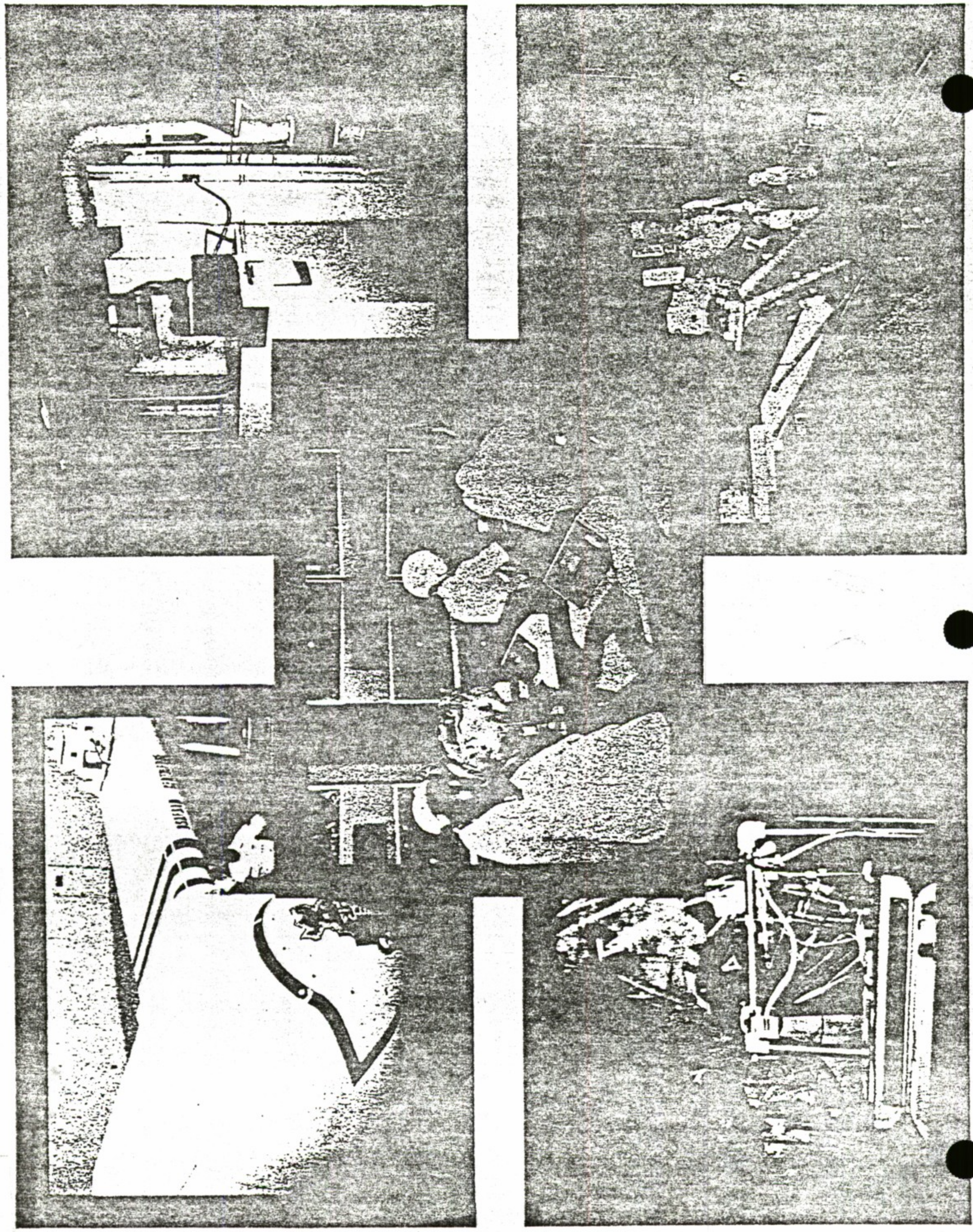
DVM – 23
MAS – 3
BAC – 1

1396 TOTAL PEOPLE IN LABORATORIES
42% S&E

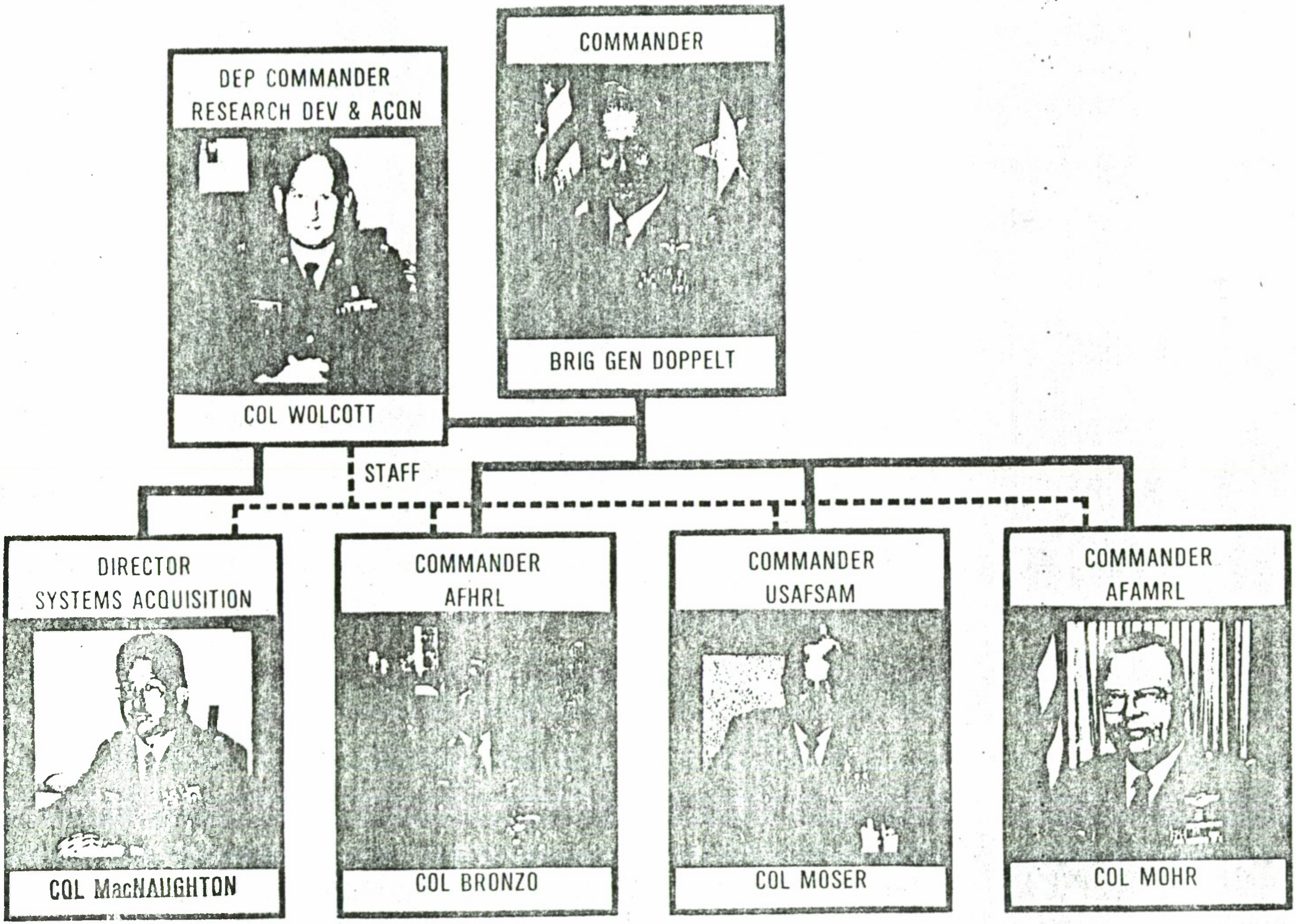
AS OF 31 DEC 84

AMD RDT&E FINANCIAL TREND



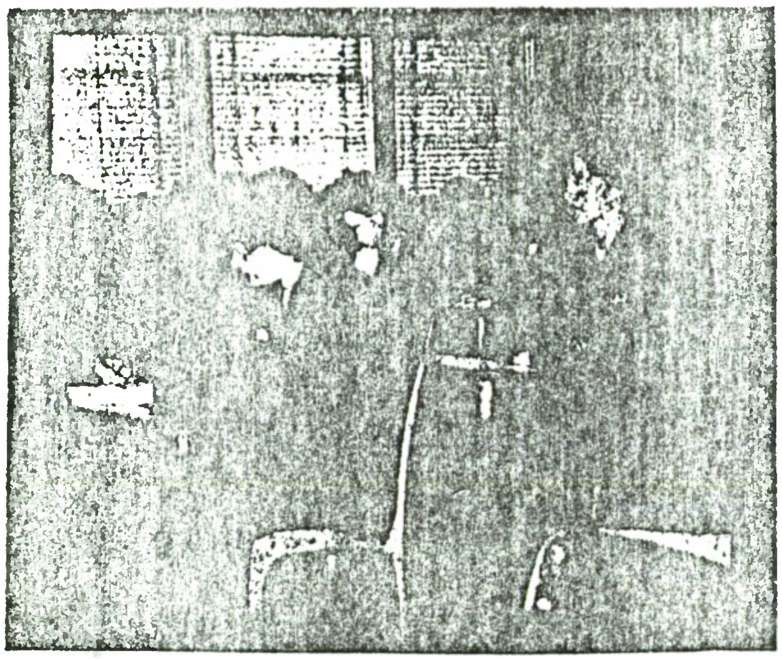


AEROSPACE MEDICAL DIVISION
RESEARCH AND DEVELOPMENT



SCIENCE AND TECHNOLOGY

MANPOWER AND FORCE MANAGEMENT



OBJECTIVES

- DEVELOP PERSONNEL QUALIFICATION TESTS
- SPECIFY AIR FORCE JOB STANDARDS
- ASSESS INDIVIDUAL JOB PERFORMANCE AND UNIT PRODUCTIVITY

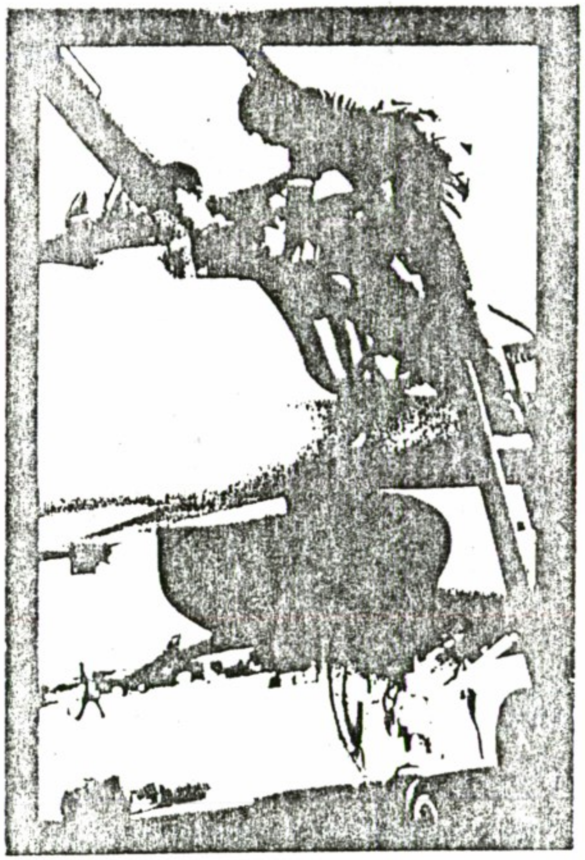
FUNDING

- PE 62703F
- PE 63704F

AMD LABS

- AFHRL/MO

TRAINING TECHNOLOGY



OBJECTIVES

- DEVELOP EFFECTIVE TECHNIQUES FOR AIR COMBAT TRAINING
- DEVELOP ADVANCED IMAGE GENERATION AND DISPLAY TECHNIQUES
- DEVELOP AN INTEGRATED TRAINING SYSTEM FOR AIR FORCE ON-THE-JOB TRAINING

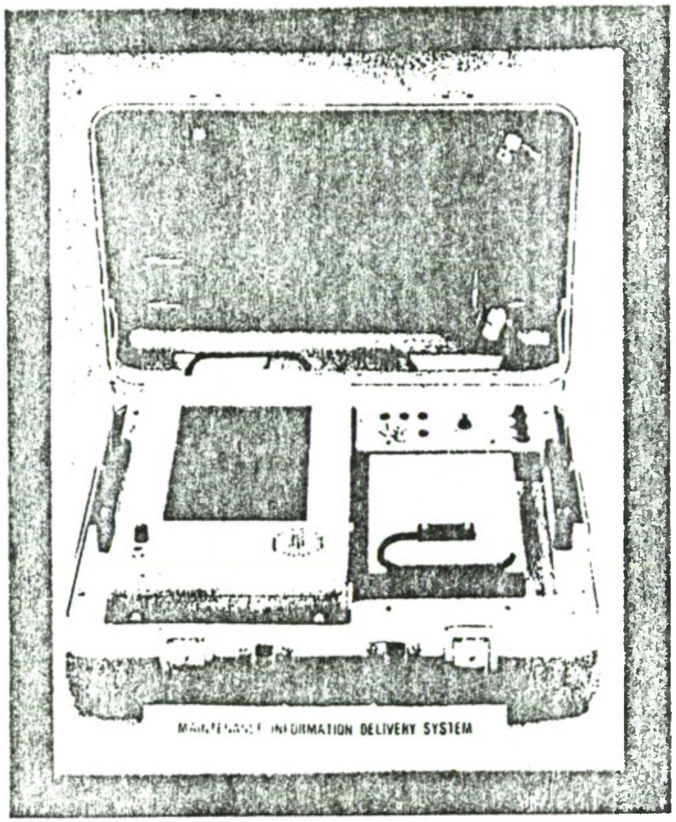
FUNDING

- PE 62205F
- PE 63227F
- PE 63751F

AMD LABS

- AFHRL ID/OT

LOGISTICS TECHNOLOGY



OBJECTIVES

- PROVIDE LOGISTICS PLANNING METHODS THAT IMPACT COMBAT CAPABILITY
- DEVELOP COMPUTER-BASED INSTRUCTIONAL SYSTEMS AND MAINTENANCE AIDS FOR AIR FORCE-WIDE USE

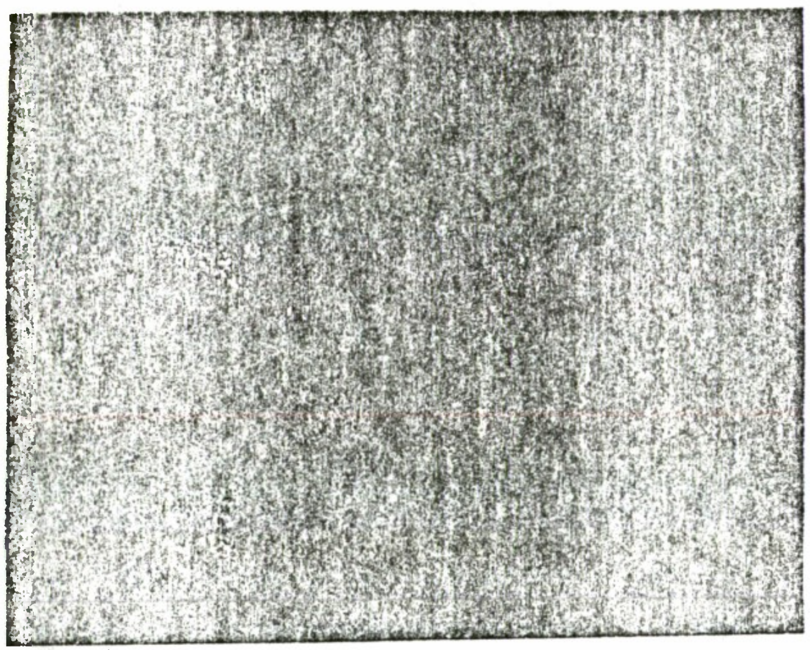
FUNDING

- PE 63106F

AMD LABS

- AFHRL/LR

CREW SYSTEMS INTEGRATION



OBJECTIVES

- INCREASE SYSTEMS EFFECTIVENESS THROUGH HUMAN-CENTERED DESIGN
- ENHANCE OPERATIONAL AIRCREW CAPABILITY

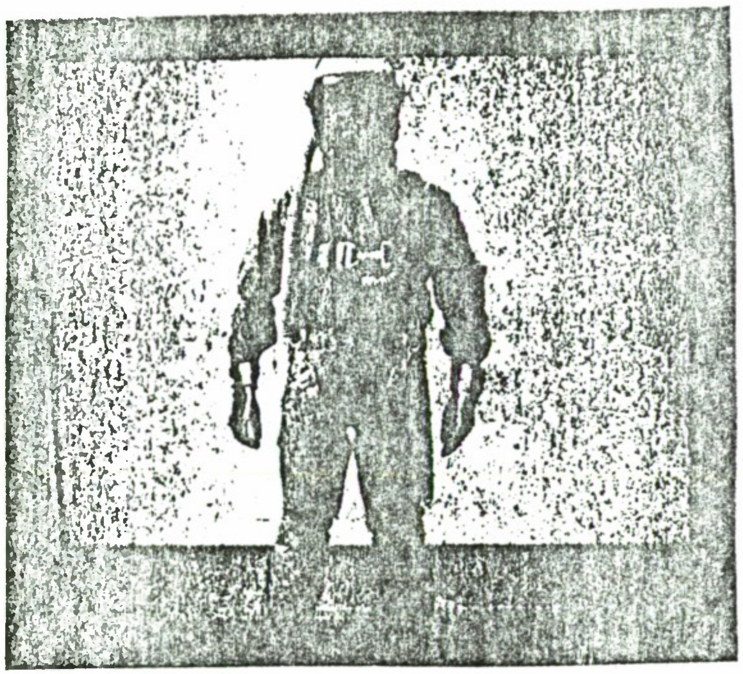
FUNDING

- PE 62202F
- PE 63231F

AMD LABS

- USAFSAM VN/NG
- AFAMRL/HE
- DIRECTORATE OF SYSTEMS ACQUISITION

CREW PROTECTION AND SURVIVABILITY



OBJECTIVES

- IMPROVE CHEMICAL DEFENSE CAPABILITIES
- INCREASE SAFETY ENVELOPE OF EMERGENCY ESCAPE
- DEVELOP INTEGRATED LIFE SUPPORT EQUIPMENT

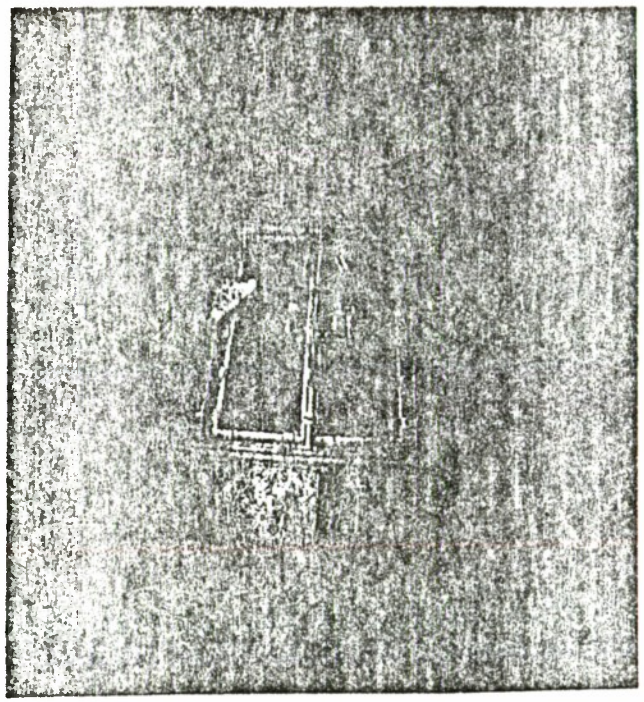
FUNDING

- PE 62202F
- PE 63231F
- PE 63745F
- PE 64703F

AMD LABS

- USAFSAM VN/NG/RZ
- AFAMRL HE/TH/BB
- DIRECTORATE OF SYSTEMS ACQUISITION

SAFETY, ENVIRONMENTAL AND MEDICAL



OBJECTIVES

- DETERMINE ACCEPTABLE LEVELS FOR CHEMICAL, NOISE AND RADIATION HAZARDS
- REDUCE HUMAN FACTOR CAUSES OF AIRCRAFT ACCIDENTS
- DEVELOP ADVANCED AIREVAC/CASUALTY TREATMENT PROCEDURES AND EQUIPMENT

FUNDING

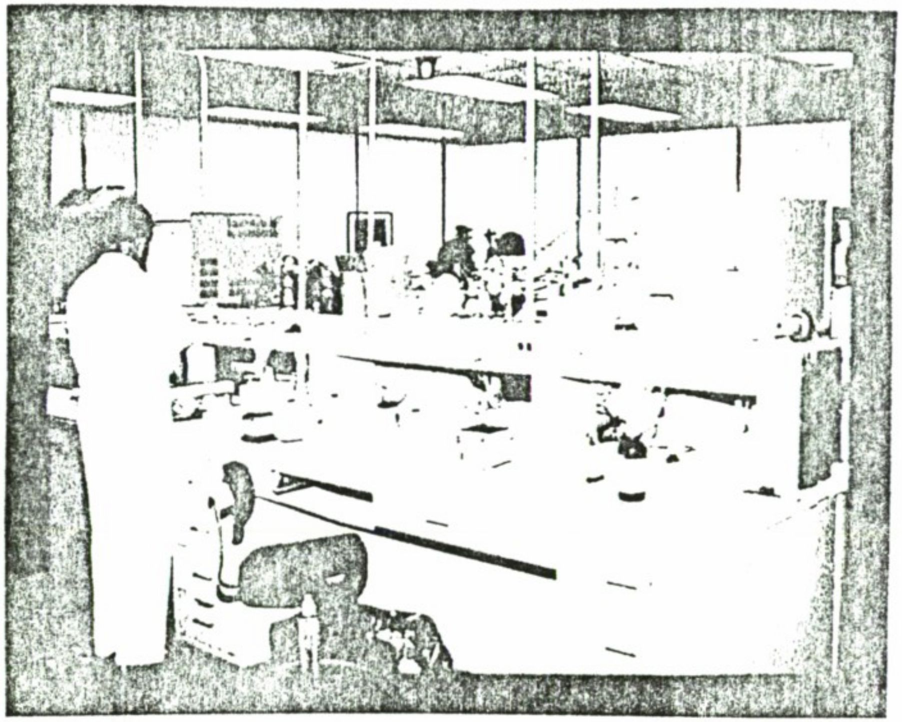
- PE 62202F
- PE 63723F
- PE 63745F
- PE 64703F
- PE 65306F

AMD LABS

- USAFSAM RZ/VN
- AFAMRL BB/TH
- DIRECTORATE OF SYSTEMS ACQUISITION

AIR FORCE DRUG TESTING LABORATORY

(AFDTL)

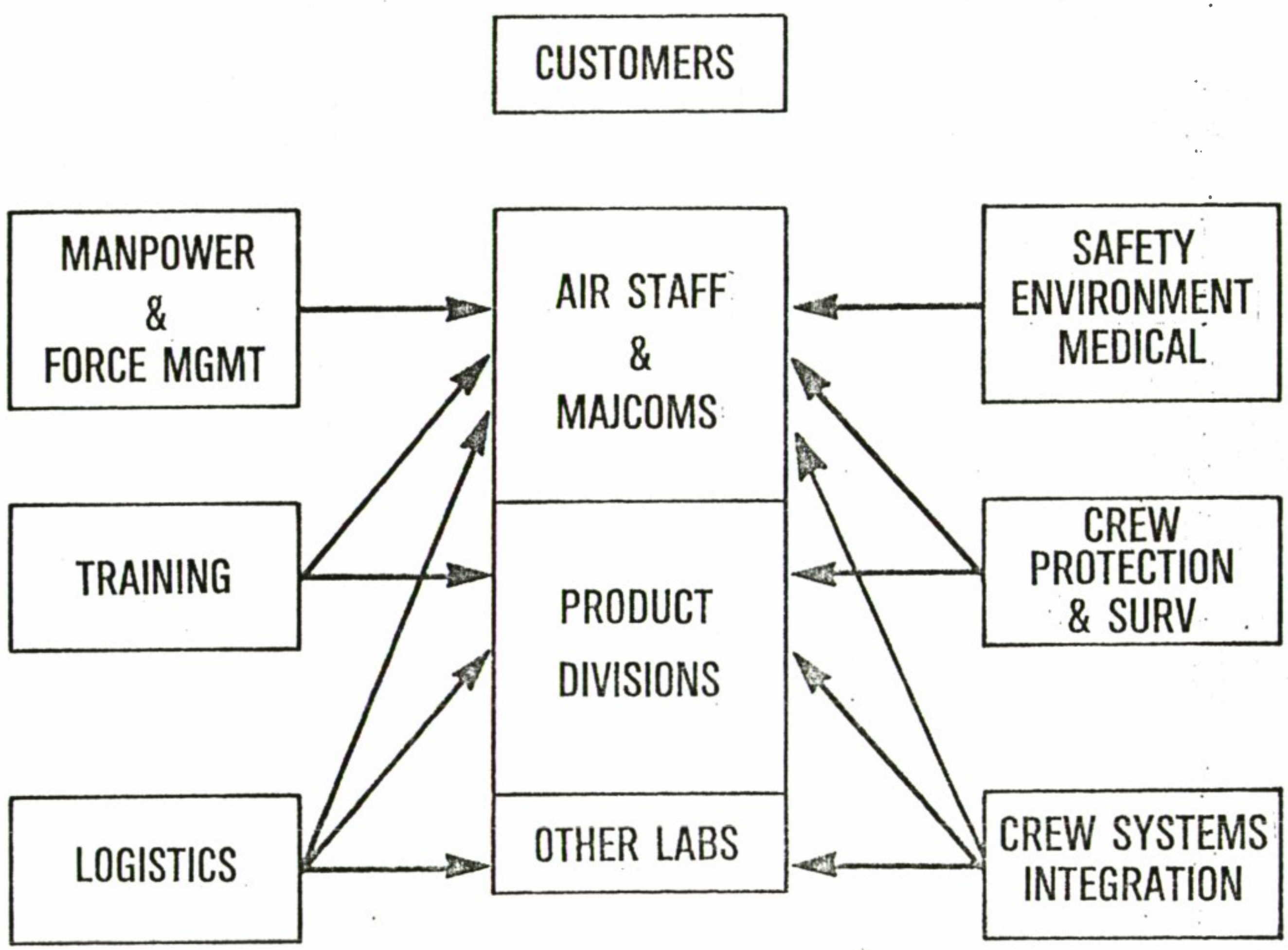


- CONUS, PANAMA, AND ALASKA USAF DRUG TESTING

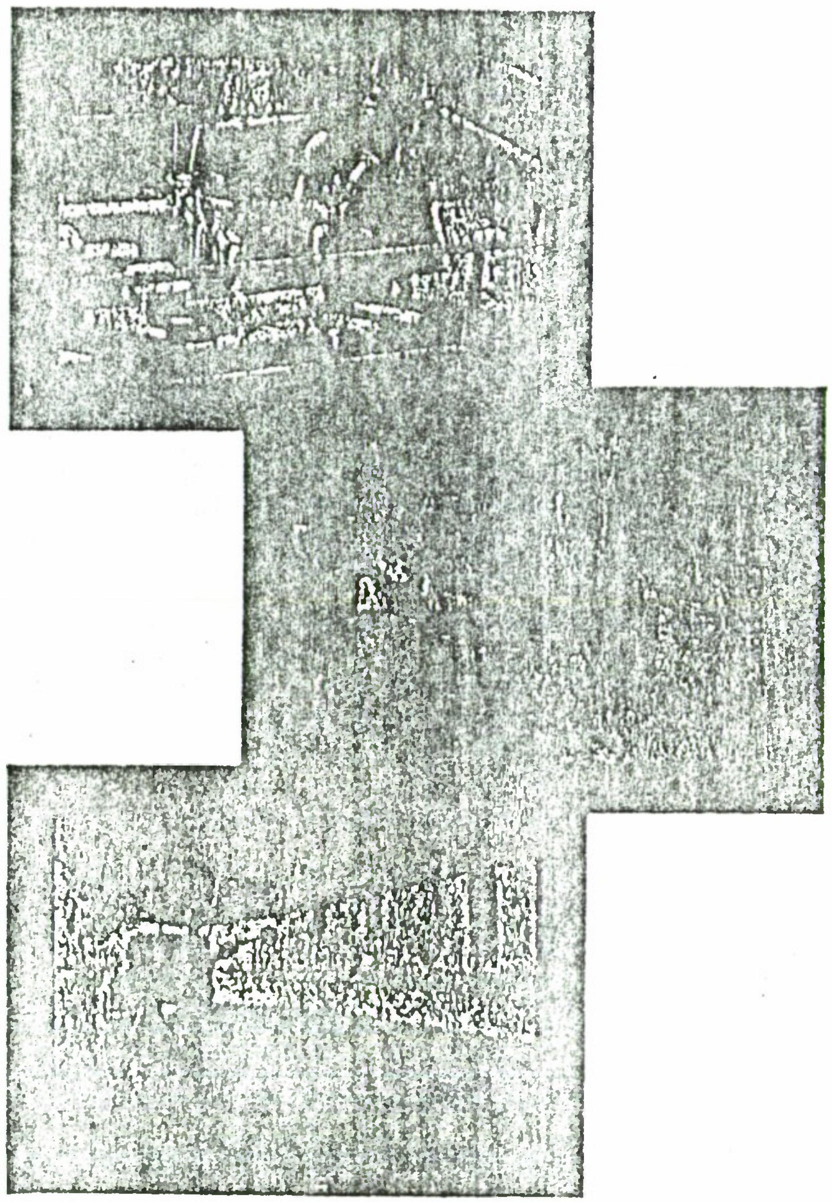
- CONUS REGIONAL ARMY DRUG TESTING
  - ALL SPECIMENS TESTED FOR THC
  - 10% OF ALL SAMPLES FOR ONE ADDITIONAL DRUG (PULSE TESTING)

- PROVIDE LEGAL ADVICE AND EXPERT WITNESS SUPPORT

TECHNOLOGY TRANSITION

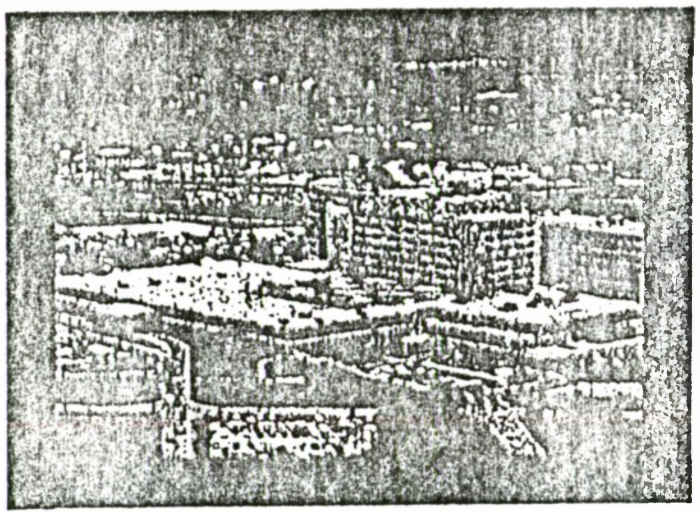


USAF OCCUPATIONAL & ENVIRONMENTAL HEALTH LABORATORY



- WORLDWIDE PROFESSIONAL CONSULTATION
- HEALTH RISK ASSESSMENT
- SPECIALIZED ANALYTICAL LABORATORY SERVICES
- OPERATIONAL FIELD SUPPORT
  - ON-SITE

WILFORD HALL USAF MEDICAL CENTER



- LARGEST AIR FORCE MEDICAL FACILITY
- 93 MEDICAL, DENTAL AND SURGICAL SPECIALTIES / SUB-SPECIALTIES
- 1,000-BED CAPACITY
- 58 OUTPATIENT SPECIALTY CLINICS
- 2,500 OUTPATIENT VISITS DAILY

ATTACHMENT G

Human Factors Engineering Guide to System and Equipment Development -- Draft Charter

CHARTER FOR THE HUMAN FACTORS ENGINEERING GUIDE TO SYSTEMS/EQUIPMENT DEVELOPMENT UPDATE COMMITTEE

This committee will define a cooperative interagency program to change and update the 1972 Human Engineering Guide to Equipment Design. Many professionals in Human Factors realize that the 1972 Guide is both dated in content and somewhat obsolete in fulfilling its guidance purposes. Research and technology bases as well as applications experience across this broad field have continued to grow far beyond the mid 1960 information that was used in the 1972 version.

The committee will formulate program approaches and content recommendations for two sequential Human Factors Reference products:

1. In a new updatable format, guidance, process and reference information on the content of "Human Factors Technology" and its application (an expanded taxonomy will be prepared as part of this effort).
2. An updatable automated storage, distribution, access and retrieval system for the above technology information, its research base and its applications' lessons learned.

The Technology

The Human Factors Technology is understood to include:

a) Considerations of human characteristics together with their environmental constraints;
b) human-machine interface concepts and criteria; and
c) human-machine systems integration processes, methods, models/data bases and lessons learned.

Product Users

The users of the information will be primarily those government and contractor personnel who develop the Human Factors Technology Base and those who apply it in human-machine systems/equipment/product acquisition and modification programs. Researchers and technology developers will use and contribute data bases, concepts and methodological guidance. Applications specialists and other design personnel will use the data and guidance and will contribute lessons learned. Thus the ultimate applications use will be as job or task aids in accomplishing human factors activities. These activities cross the life cycle spectra of systems from early requirements generation through creative design to operational evaluations and address potential mid-life mission and modification changes.

Human Factors applications are integral to all aspects of human use (operation, maintenance, support, control and management of systems and subsystems). Therefore, interactions with systems engineering, safety, life support subsystems, overall logistics support, and in-being training, technical data, and personnel acquistion systems are important. Such interacting interests need to be considered for the new HF reference products.

Human factors professionals in non-government system acquisition and equipment, product or service development and improvement activities could benefit from the two reference products. A growth capability to address their needs would be considered in developing the initial DoD/NASA products. Non-government involvement would be necessary for any extended effort that would develop and maintain any such commercial product related content. Technical and professional society interests and outside funding will help determine any such extensions.

Additionally in the cases of both government and private developments, some human factors activities are undertaken by people in associated occupational areas and professional groups. The reference material should be helpful to them. In many cases it should help them to realize that they should turn to the human factors field for interpretations and problem solving.

Some technical material in the guide should be aimed at the managers who potentially need human factors assistance. This content should deal with what can be done, when and what to expect.

Although the resultant guides will be useful as academic references they will not be aimed at such a use nor will they be developed as textbook substitutes.

Committee Process

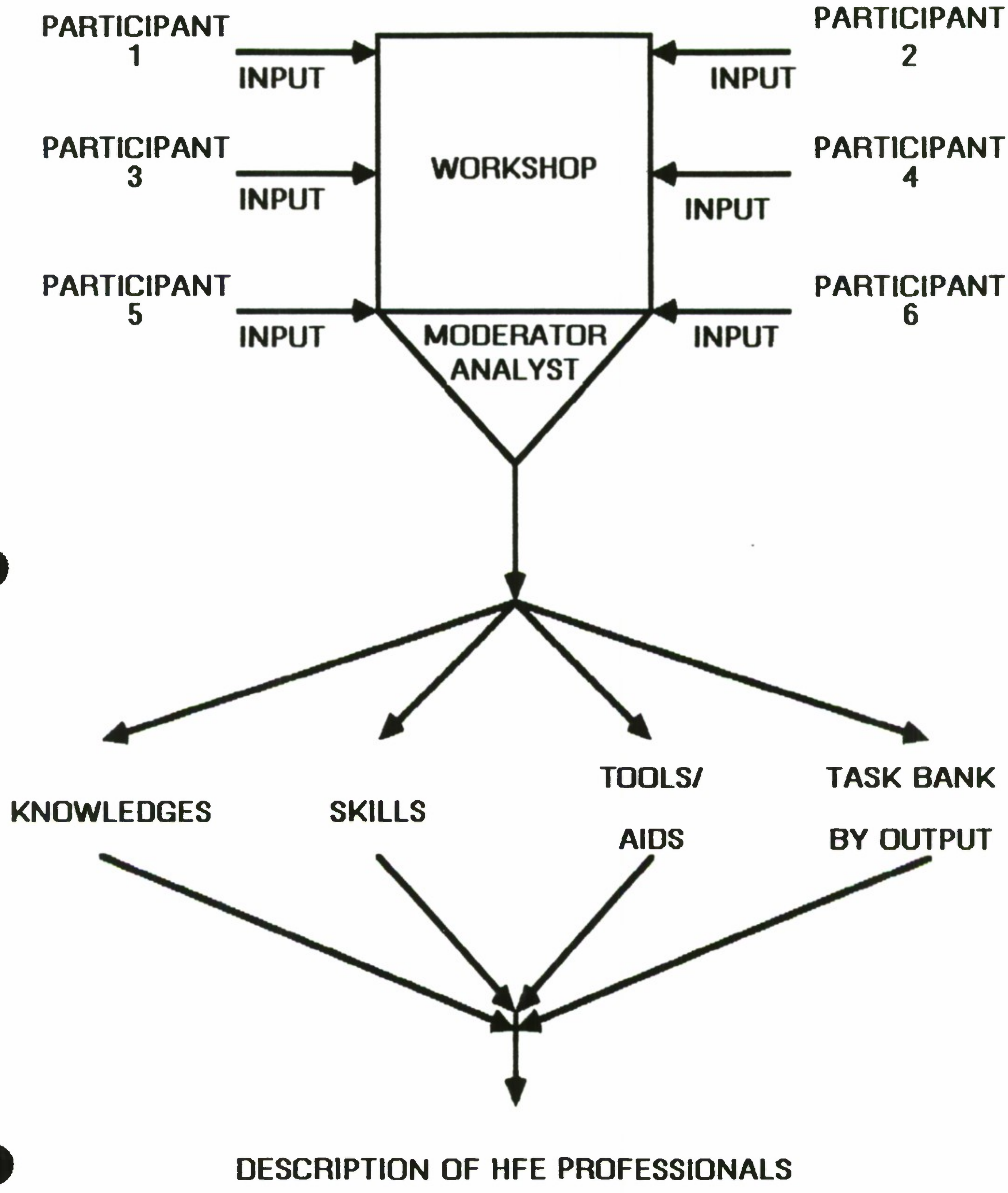
The committee's program approaches will be presented to the Operating Board and a multiagency steering group will be established to oversee the implementation of the selected program.

ATTACHMENT H

Professional Education, Training and Career Development -- View Graphs

HFE OCCUPATIONAL DATA BASE AND "STANDARDS" DEVELOPMENT

WORKSHOP FLOW DIAGRAM



HFE Occupational Data Base and Standards Development (DoD TAG effort).

WORKSHOP 1 – SEPT 24–25, 1984

HFE Specialists in RDT&E in Military Systems.

ATTENDEES:

Wolf Hebenstreit,	Boeing Aircraft
Albert Mack,	Honeywell
Bruce Hamilton,	Sikorsky
Jack Carlock,	U.S. Army, HEL Det., Dover
Craig McLean,	U.S. Air Force, Human Factors & Instructional Systems, ASD
Julien "Chris" Christenson,	Universal Energy Systems (Substituting for U.S. Navy Participant)

WORKSHOP 2 – DEC 4–5, 1984

HFE Specialists in Consumer/ Commerical Systems.

ATTENDEES:

Teresa Baird,	Xerox
Nicholas Simonelli,	3M
Tim Kuechenmeister,	General Motors
William Cushman,	Eastman Kodak
Howard Glaser,	IBM
David Clark,	NCR

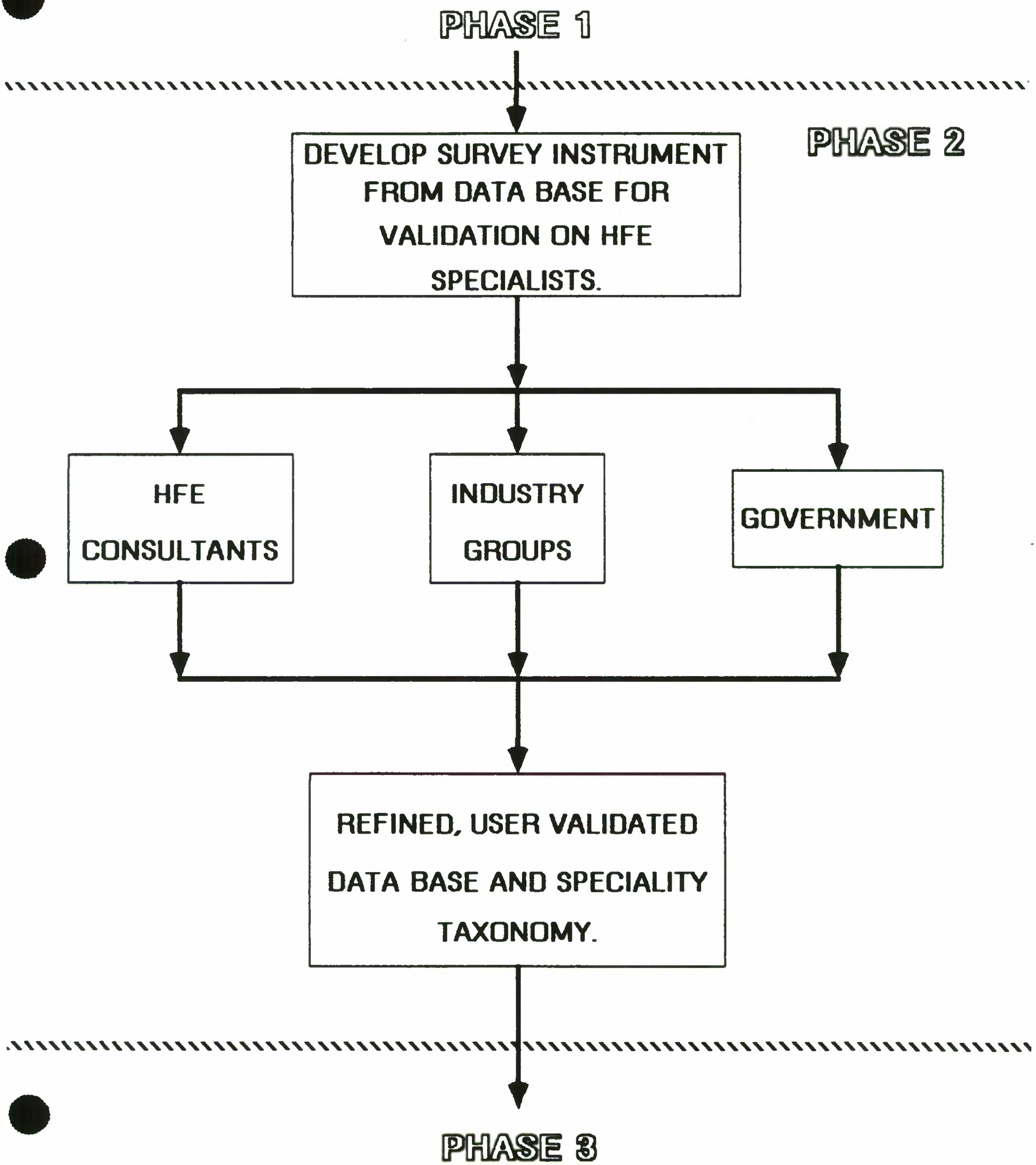
WORKSHOP 3 – MAR 12–13, 1985

HFE Specialists in Forensics/ Safety.

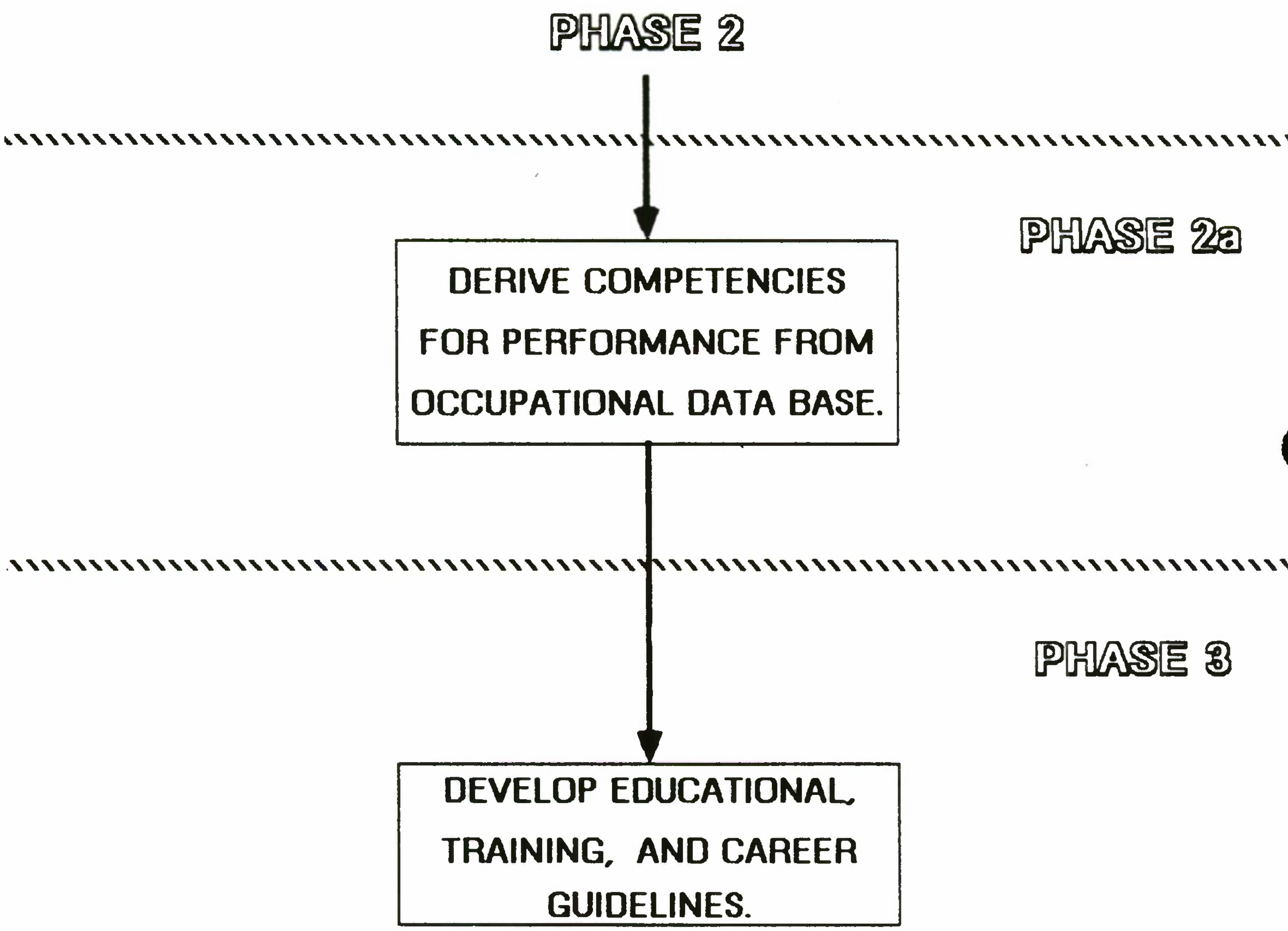
ATTENDEES:

Jerry Duncan,	John Deere
John Howard,	Universal Energy Systems
Bob Meirer,	Consultant
Gordon Robinson,	University of Wisconsin, Consultant
Bradley Hammond,	Consultant

HFE OCCUPATIONAL DATA BASE AND "STANDARDS" DEVELOPMENT



HFE OCCUPATIONAL DATA BASE AND "STANDARDS" DEVELOPMENT



ATTACHMENT I

Technical Society/Industry Committee -- View Graphs

Lockheed-California Company

SOFTWARE TECHNOLOGY FOR ADAPTABLE RELIABLE SYSTEMS (STARS)

COMBINED REPORT TO THE
TECHNICAL SOCIETY/INDUSTRY (TS/I) COMMITTEE
AND THE
USER-COMPUTER INTERFACE (UCI) SUB-TAG
OF THE
DEPARTMENT OF DEFENSE (DoD) - HUMAN FACTORS ENGINEERING (HFE) -
TECHNICAL ADVISORY GROUP (TAG)

MAY 07, 1985

DR. MARK M. BRAUER, CHAIRMAN
COMBINED TS/I - UCI WORKING GROUP (WG III)

OUTLINE

A. STARS MEETINGS - SAN DIEGO (28 APRIL - 2 MAY 1985)

1. ENTHUSIASTIC ATTENDANCES

2. CO-LOCATED, CONSECUTIVE DoD AND NSIA CONFERENCES

3. (16) NSIA SESSIONS

4. (4) GUEST SPEAKERS - EXPERTS FROM ABROAD

5. (3) MAIN ISSUES (A COMMON THEME)

6. (2) SPECIAL INVITATIONS

7. SYMBIOTIC EFFECT
    - o CERTIFICATION/LICENSING & EDUCATION/TRAINING
    - o OPERATIONAL CONCEPTS DOCUMENT (OCD)

B. TECHNICAL SOCIETY/INDUSTRY, DoD AND ACADEMIC PERSONNEL WORKING GROUP

1. SUPPORT TO UCI INITIATIVE

2. TS/I-UCI WORKING GROUP COMPOSITION

G1B-113:28

STARS HIGHLIGHTS

1. GREATER THAN 450 PROFESSIONALS* IN ATTENDANCE (THERE WAS OVERWHELMING SUPPORT TO ANNUALIZE THIS MEETING)

2. 1-DAY DoD OVERVIEW VASTLY ENHANCED BY NSIA's WEEK-LONG SESSIONS DEALING MAINLY WITH (8) TOPICS PRESENTED, CHAIRED AND/OR CO-CHAIRED AS FOLLOWS:
   - o SOFTWARE TECHNOLOGY INITIATIVES, DR. ED LIEBLIEN, DoD DIRECTOR, CSS
   - o FUNCTIONAL SOFTWARE ENGINEERING ENVIRONMENT, PHIL ANDREWS, NAVSEA
   - o METHODOLOGY/TOOLS, DR. MERLINE DORFMAN, LOCKHEED
   - o HUMAN RESOURCES AND THE SOFTWARE ENGINEERING INSTITUTE, JOE FOX, SOFTWARE A&E
   - o BUSINESS PRACTICES, JACK COOPER, CACI
   - o MEASUREMENT, JIM MCCALL, SAIC
   - o APPLICATIONS, RAY DION, RAYTHEON
   - o CONNECTING TECHNOLOGIES, RAY RUBEY, SOFTECH

3. SIXTEEN NSIA SESSIONS ARE LISTED ON THE ATTACHED OFFICIAL PROGRAM AS DIRECTED BY JOE BATZ, DoD AND CHAIRED BY MAC MURRAY, GD

---

* ACADEMICIANS, GOVERNMENT PERSONNEL - BOTH MILITARY AND CIVILIAN, AND INDUSTRIALISTS.

G1B-113:28

4. GUEST/INVITED SPEAKERS (4):
   - o BRAIN OAKLEY, ALVEY, GREAT BRITIAN
   - o DR. RAY YEH, INTERNATIONAL SOWRE, JAPAN AND BRAZIL
   - o HORST HUNKE, ESPRIT, EUROPE
   - o LAZLO BELADY, MCC, THE UNITED STATES

5. REAL, TIMELY PROGRESS CAN BE EXPECTED ON THE FOLLOWING ISSUES:
   - o PERSONNEL (PROFESSIONALISM, GROWTH AND RETENTION, AND THE 2-K SHORTFALL)
   - o REUSABILITY (MODULARITY, INCENTIVES FOR REUSE)
   - o SOFTWARE LIBRARY (THE COMPARATIVE EASE WITH WHICH DATA CAN BE ENTERED AND, CONVERSELY, THE DIFFICULTY OF ITS ACCESS)

6. WE RECEIVED (2) SPECIAL INVITATIONS, AS FOLLOWS:
   - o PARTICIPATE WITH STARS IN AI/ES AND DECISION AIDING/AUGMENTATION
   - o CRITIQUE JOINT SERVICE SOFTWARE ENGINEERING ENVIRONMENT (JSSEE) OPERATIONAL CONCEPT DOCUMENT (OCD)

G1B-113:28

7. OUR PRESENCE/PARTICIPATION HAD A SYMBIOTIC EFFECT, AND GAVE US THE ABILITY TO:

   - o IDENTIFY AND CONTACT BOB BLANCHARD REGARDING THE COMPUTER SCIENTIST CERTIFICATION/LICENSING ISSUE. (BOB AGREED TO, AND WILL PROBABLY BE RECRUITED TO, RUN THIS EFFORT IN PARALLEL WITH THE HFS/HFE ACTIVITY TO GIVE THIS TECHNICAL COMMUNITY TWICE THE BANG FOR THE BUCK.)
   - o DISTRIBUTE COPIES OF THE JSSEE-OCD TO INTERESTED TAG MEMBERS WITH THE PROVISION THAT THE REQUESTED CRITIQUE BE FULFILLED, THUS PROVIDING STARS WITH MUCH BROADER COVERAGE.

ATTACHMENT: COPY OF ORIGINAL NSIA PROGRAM/AGENDA (2-PAGES)

TS/I SUPPORT TO UCI INITIATIVE

GOAL	OBJECTIVES
INTEGRATE DEFENSE RELATED THRUST AREAS	IDENTIFY TECHNICAL SOCIETY/DoD/ACADEMIC/INDUSTRY WORKING-GROUP (COMPLETED)
PRODUCE GUIDELINES FOR INTERFACE HARDWARE/ SOFTWARE DESIGN	PRODUCE A STRAWMAN CHARTER (IN PROGRESS)
PROVIDE FORUM FOR FREE EXCHANGE OF TECHNICAL IDEAS AND INFORMATION	INVESTIGATE INTERFACE COMPLEXITY AND WORKSTATION DESIGN (BEGUN)
ENHANCE EFFICIENCY OF THE UCI DESIGN PROCESS	COORDINATE WITH THE TAG/UCI GROUP GUIDELINES DOCUMENTS (IN PROGRESS)
FACILITATE INSERTION OF STARS PRODUCTS INTO INDUSTRY MAINSTREAM*	INCREASE TECHNOLOGY ABSORPTION (BEGAN TECHNICAL LITERATURE COLLECTION PROCESS*)

MILESTONES

FY85
1. BEGIN TS/I SUPPORT
2. COORDINATE WITH STARS HUMAN RESOURCES AND UCI
   (ACCOMPLISHED)
3. ARTIFICIAL INTELLIGENCE PRESENTATION SET FOR NEXT FALL's TAG

PROJECTED FUNDING

FY85	FY86	FY87	FY88
100K	400K	850K	1.4M

PROGRESS TO DATE

INDUSTRY APPROVAL AND PARTICIPATION HAS BEGUN

COORDINATION MEETING PLANNED

RESEARCH AWAITING FUNDING

IRAD FUNDING AVAILABLE

* IN FACT, THIS WORKING GROUP SUCCESSFULLY COORDINATED EFFORT WITH:

1. DR. KEN BOFF's DESIGN-GUIDE ACTIVITY AT WRIGHT-PATTERSON AFB
2. DAVE ALEXANDER's TEXTUAL WORK AT TENNESEE-EASTMAN
3. BATTELLE

G1B-113:28

G1B-113:29

TS/I-UCI INITIAL WORKING GROUP III COMPOSITION

1	HUGHES	10	NSC
2	FAA	11	AAES
3	NASA	12	NRC
4	ANSI	13	DOE
5	SINGER-LIBRASCOPE	14	MARTIN-MARRIETTA
6	ISO	15	BATTELLE
7	AIIE	16	SSS
8	MCDONNEL DOUGLAS	17	AAAI
9	NBS	18	LOCKHEED

19 EG&G - IDAHO FALLS

* GREATER THAN 250 DIRECTLY RELATED YEARS OF EXPERIENCE (AVERAGE APPROXIMATELY 20 YEARS,)

G1B-113:28

THURSDAY — 2 MAY (Continued)

1600 CONFERENCE REVIEW (Continued)

Panel Participants (Continued)

Industry (Continued)
Dr. Terry Straeter, General Dynamics
Dr. Barry Boehm, TRW
Dr. Bill Wulf, Tartan
Mr. Al Whittaker, Honeywell
Mr. Donn Philpot

1700 ADJOURN

NSIA SOFTWARE COMMITTEE

in cooperation with the

DEPARTMENT OF DEFENSE

AND THE
ACM AIA
AIAA
EIA IEEE CS

PRESENT THE FIRST DOD/INDUSTRY

STARS PROGRAM CONFERENCE

30 April 1985 — 2 May 1985
San Diego Hilton,
San Diego, California

PURPOSE

The purpose of the conference is to bring together representatives of government, industry, and the academic community to review and discuss the DoD STARS (Software Technology for Adaptable, Reliable Systems) Program, and other components of the DoD Software Initiative (Ada*, and the Software Engineering Institute). The STARS Program is currently funded at $15 million (FY85). The planned funding level for next year (FY86) is $52 million.

A feature of this conference will be the presentation of world-wide software technology initiatives, including the Alvey, ESPRIT and Brazilian programs, the Japanese 5th generation program and the MCC Software Task Area program.

*Ada is a registered trademark of the US Government (AJPO)

INDUSTRY CONFERENCE CHAIRMAN
Mr. Mitch Mesecher, Sperry

DoD CONFERENCE CO-CHAIRMEN
Dr. Ed Lieblein, DoD Director, Computer Software & Systems
Mr. Joe Batz, DoD Acting STARS Program Director

PROGRAM CHAIRMAN
Mr. Mac Murray, General Dynamics

PROGRAM VICE-CHAIRMAN
Ms. Marilyn Stewart, Logicon

PUBLICITY CHAIRMAN
Mr. Jack Devlin, Vitro

LOCAL ARRANGEMENTS CHAIRMAN
Ms. Stacy Reddan, General Dynamics

ASSOCIATION REPRESENTATIVES
A — Mr. Herb Conn, General Dynamics
AIA — Mr. Terry Savage, TRW
AIAA — Mr. Bob Jones, Hughes
EIA — Mr. Jerry Raveling, Sperry
IEEE CS — Mr. Perry Nuhn, ITT
NSIA — Dr. Check Lao, Sperry

PROGRAM

MONDAY — 29 APRIL 1985

1700-1900 REGISTRATION *Foyer*

TUESDAY — 30 APRIL 1985

0730 REGISTRATION *Foyer*

0900 WELCOME AND INTRODUCTIONS
Mr. Mitch Mesecher, Sperry

0915 KEYNOTE ADDRESS
DoD SOFTWARE TECHNOLOGY INITIATIVES — PAST, PRESENT AND FUTURE
Dr. Ed Lieblein, DoD Director, CSS

1000 OVERVIEW OF THE STARS PROGRAM
Mr. Joe Batz, Acting STARS Program Director

1045 BREAK

1100 SERVICE PERSPECTIVES ON THE STARS PROGRAM
Mr. Jim Hess, Army
Capt. Dick Holt, Navy
Col. Ken Nidiffer, Air Force

1200 POOLSIDE RECEPTION

1230 LUNCH *Main Ballroom*
Speaker
Mr. Brian Oakley, Alvey
Topic:
UNITED KINGDOM SOFTWARE TECHNOLOGY INITIATIVES

1445 SOFTWARE ENGINEERING ENVIRONMENTS SESSION
Session Chair
Mr. Bob Charette, SofTech

TUESDAY — 30 APRIL (Continued)

1445 SOFTWARE ENGINEERING ENVIRONMENTS SESSION (Continued)

Functional Area Overview
Mr. Phil Andrews, NAVSEA

Technical Considerations of a SEE
Mr. Ray Bollinger, Boeing

Implanting a Standard SEE into Industry
Mr. Paul Mauro, Hughes

Additional Panelists
Mr. Thomas Conrad, NUSC
Mr. Hank Stuebing, NADC

1645 BREAK

1700 BIRDS OF A FEATHER

STARS Service Program Managers *Mediterranean Room*

Software Engineering Environments *Caribbean Room*

1830 POOLSIDE RECEPTION

1930 CONFERENCE BANQUET

Speaker
Dr. Raymond Yeh, International Software

Topic:
JAPANESE AND BRAZILIAN SOFTWARE TECHNOLOGY INITIATIVES

WEDNESDAY — 1 MAY 1985

0800 METHODOLOGY SESSION

Session Co-Chairmen
Mr. Mark Gerhardt, Mitre
Dr. Merline Dorfman, Lockheed
Mr. Harry Lehrhaupt, GE

Functional Area Overview
Mr. George Sumrall, CENTACS

WEDNESDAY — 1 MAY (Continued)

0800 METHODOLOGY SESSION (Continued)

Methodology, The Pragmatic View
Dr. Roger Bate, TI

Methodology, The Visionary View
Mr. Grady Booch, Rational

Additional Panelists
Mr. Tony Brintzenhoff, Syscon
Mr. Ole Golubjatnikov, GE

1000 BREAK

1015 BUSINESS PRACTICES SESSION

Session Chairman
Mr. Jack Cooper, CACI

Functional Area Overview
Mr. Phil Babel, ASD

Impact on the Contractor (Big)
Dr. Thomas Martin, RCA

Impact on the Contractor (Small)
Mr. Joe Fox, Software A&E

Additional Panelists
Mr. Mike Greenberger, Shea & Gardner
Dr. Bill Wulf, Tartan

1215 POOLSIDE RECEPTION

1245 LUNCH *Main Ballroom*

Speaker
Mr. Horst Hunke, ESPRIT

Topic:
EUROPEAN SOFTWARE TECHNOLOGY INITIATIVES

1445 MEASUREMENT SESSION

Session Chairman
Mr. Jim McCall, SAIC

Functional Area Overview
Mr. Joe Cevano, RADC

Software Measurement Issues
Dr. Barry Boehm, TRW

Data Collection
Mr. John Bowen, Hughes

WEDNESDAY — 1 MAY (Continued)

1445 MEASUREMENT SESSION (Continued)

Operational Measurement
Mr. Bob Thibodeau, GRC

1645 BREAK

1700 BIRDS OF A FEATHER

Methodology *Mediterranean Room*

Business Practices *Caribbean Room*

Measurement *South Pacific Room*

830 SPECIAL EVENT
SAN DIEGO HARBOR CRUISE

THURSDAY — 2 MAY 1985

0800 APPLICATIONS SESSION

Session Co-Chairmen
Mr. Ray Dion, Raytheon
Mr. Jim Lepsch, Textron

Functional Area Overview
Ms. Bets Wald, NRL

Systems Engineering Aspects of Software Reusability
Ms. Joyce Morrison, Sperry
Mr. Wayne Smith, RCA

Reusable Software Implementation Technology Reviews
Dr. James Winchester, Hughes
Dr. Chang Huang, Hughes
Mr. Bill Noble, Hughes

Additional Panelist
Mr. Laszlo Belady, MCC

1000 BREAK

015 HUMAN RESOURCES SESSION

Session Chairmen
Mr. Joe Fox, Software A & E

Functional Area Overview
Mr. Joe Kernan, CECOM

THURSDAY — 2 MAY (Continued)

1045 SOFTWARE ENGINEERING INSTITUTE

Session Chairman
Mr. Joe Fox, Software A & E

Overview of the SEI
Maj. Dan Burton, USAF/ESD

SEI Implementation
Dr. Mary Shaw, Chief Scientist, SEI

1145 POOLSIDE RECEPTION

1215 LUNCH *Main Ballroom*

Speaker
Mr. Laszlo Belady, MCC

Topic:
US SOFTWARE TECHNOLOGY INITIATIVES — MICROELECTRONICS AND COMPUTER TECHNOLOGY CORPORATION (MCC)

1445 CONNECTING TECHNOLOGIES SESSION

Session Co-Chairmen
Mr. Ray Rubey, SofTech
Mr. Paul Wood, Sperry

Ada Validation Policy Update
Dr. Dudrey Smith, Lear Siegler

Software Test and Evaluation Project
Ms. Ronnie Martin, Georgia Tech

1545 BREAK

1600 CONFERENCE REVIEW AND COMMENT (or Raleigh Revisited) DoD and Industry Perspectives

Panel Participants

DoD/STARS
Mr. Joe Batz

Industry
Dr. Roger Bate, Texas Instruments
Dr. John Manley, Computing Technology Transition Inc. and NASTEC Corp.

ATTACHMENT J

Controls and Displays -- View Graphs

PROPOSED CHARTER
FOR THE ADVANCED DISPLAY
SUB-TECHNICAL ADVISORY GROUP
OF THE DOD HUMAN FACTORS
ENGINEERING TECHNICAL ADVISORY GROUP

OBJECTIVES

The objective of this group is to assure that the development of advanced display systems for use by human operators is done consistent with the principles of human factors.

This sub TAG is not intended to supplant any other organization that already exists. Rather, it is intended to provide a means by which all DOD/NASA personnel who are working in the area of displays can maintain a high level of awareness and currency of developments in displays as they occur.

SCOPE

This sub TAG will concern itself with the concept of displays in a broad sense because of the proliferating technology of information transfer. Any device which can be used to provide information to a human operator will be of interest. Keeping in mind that this may mean some overlap between areas of interest to this sub TAG and other organizations, this sub TAG will sustain a free exchange of information with other organizations and will cooperate with them in every possible way.

FUNCTION

The sub TAG will implement its objective by pursuing these functions: (a) serve as a forum or clearing house for the exchange of ideas and information about the latest work done or in progress in the display area; (b) provide an interface group for the development of joint support of research or development efforts which would be beyond the capacity of any individual sponsor; (c) assist in the standardization of display characteristics where needed. Insuring a free opportunity for sustaining successful coordination across service and department lines is a paramount concern.

ORGANIZATION

As a subordinate organization to the HFETAG, this sub TAG is subject to the pleasure of the senior body and operates under the provisions of its operating structure.

MEMBERSHIP

This sub TAG shall be open to any DOD/NASA personnel who are working in displays and who participate in the Human Factors Engineering TAG. Representatives of technical and industrial associations as appropriate under TAG policy may also participate.

CHAIR

The chairman shall be elected annually by members attending the first meeting of the calendar-year. The chairman may succeed himself so long as he is duly re-elected.

MEETING

This sub TAG shall meet in conjunction with the regular HFETAG meetings. The exact time and place shall be determined by the Chair or a person designated by the Chair and members advised by mail prior to the meeting.

ATTACHMENT K.1

Human Factors Test and Evaluation -- View Graphs

DoD HFE T&E Sub-TAG Meeting

30 April & 1 May 1985

Patuxent River Naval Air Test Center, MD

PRESENTATIONS

- Task Analysis Standard and Handbook (Future MIL-STD XXXX?)
- Flight Tests of Voice Command Interactive Device in the F/A-18
- Systems Analysis Approach to Chemical Protective Systems on the DDG-51
- Inflight Data Acquisition System
- Questionnaire Development for use in T&E
- Report on ITEA Workshop on "Technology and T&E in the Defense Acquisition Process"
- HFE in T & E at Pacific Missile Test Center

DEMONSTRATIONS/TUTORIALS

- MINI WORKLOAD ASSESSMENT DEVICE
- AUTOMATED SPECIFICATION/STANDARD DIRECTORY
- SPEECH TRANSMISSION INDEX DATA ACQUISITION SYSTEM

TOURS

- AIRCREW STATION TECHNOLOGY ASSESSMENT LABORATORY
- TACTICAL AVIONICS TESTING & EVALUATION FACILITY

ACTION ITEMS

- LESSONS LEARNED DATA BASE
- 1553 DATA BUS UTILIZATION IN T&E
- EVALUATION OF COLOR DISPLAYS
- TASK ANALYSIS STANDARD AND HANDBOOK

ATTACHMENT K.2

Human Factors Test and Evaluation -- Proposed Charter

CHARTER, HUMAN FACTORS TEST AND EVALUATION SUBGROUP OF THE TECHNICAL ADVISORY GROUP

Objectives

The objectives of the HF T&E Sub-TAG are to provide technical HF assistance in the execution of T&E and to promote coordinated efforts within the DoD and among all government of HF T&E techniques. This Sub-TAG is intended to provide a forum for technical information exchange and to serve as a working level coordination group.

Procedures

The objectives will be accomplished by means of technical information exchanges, discussions and workshops. These discussions and workshops will include, but are not necessarily limited to, the following general topic areas:

a. System Performance including:

(1) Identification, development, validation and standardization of HF techniques or procedures used during T&E.

(2) Improvement of HF specification/standards and data item description used during design and T&E.

(3) Identification of HF T&E requirements.

b. Information; specifically:

(1) Improving inter-service utilization of information collected during T&E.

(2) Assisting T&E activities in the training of their HF personnel.

(3) Development of HF T&E data base and technology demonstrations. Specifically, "LESSONS LEARNED".

c. Management:

(1) Examining how HF related management decisions are made.

(2) Improving management's awareness and use of the contribution of HF T&E.

(3) Provide advice on Tri-Service implications of DoD Directives, Regulations and other management documents as they impact on HF T&E.

(4) Training human factors T&E personnel.

Composition

For the routine operation of the Sub-TAG, only military organizations in each service whose activities are directly or primarily involved in the test and/or evaluation of equipment and software will be invited to participate in all meetings. In addition, other government organizations which may have specific HF T&E interests will be invited to meetings. On occasion, contractors who have developed techniques, methodologies or instrumentation relevant to HF T&E may be invited to make presentations at Sub-TAG meetings. Technical society participation is invited.

Concept of Operation

The HF T&E Sub-TAG will meet not less than twice a year. Participants are encouraged to communicate informally among themselves, with a copy of their informal correspondence being sent to the TAG Chairman for information purposes. At Sub-TAG meetings participants may be requested to, or may volunteer to, prepare presentations on topics of interest to the Sub-TAG. In addition, if an item of interest to the group arises between meetings, the Chairman may request a participant, or group of participants, to make a presentation. Ad Hoc Committees will be established as necessary.

The criterion to be employed regarding topics to be addressed at HF T&E meeting is: "Will this information allow me to improve my HF T&E?"

TAG Chairmanship

Each service will designate a representation to serve as that service's focal point for the Sub-TAG. One of these representatives will act as Chairman of the Sub-TAG. Sub-TAG Chairmanship will periodically rotate among the three services. Considerable informal communication is expected between these representatives. The Sub-TAG Chairman will keep OUSDRE/ELS apprised of Sub-TAG coordination.

ATTACHMENT L.1

Manned System Modeling -- Report and Attendee List

MANNED SYSTEM MODELING SUBTAG

MAY 7 1985

AGENDA

Discussion of trends in simulation modeling area

- machine intelligence/robotics
- neural simulation
- AI/strategy planning - supervisory control
- modeling languages vs. hardware architectures in simulation
  - molecular computing
  - massively parallel machines
  - ensemble machines

Completion of Charter

- membership eligibility
- acceptable content areas

New development in DoD

Presentation of R&D at NASA - Ames

- A^3I - James Hartzell

DOD HFE TAG MODELING SUBTAG
JTCG-HFE/HMI PROPOSALS

C. C. Jorgensen
Modeling Chair

#1. Problem: Complex system simulation with high fidelity mixes of hardware and human crews are too expensive to evaluate in field exercises and too large to simulate with high fidelity.

Approach: Recent changes in supercomputing, ensemble machines and massive parallel architectures are creating new potentials not previously available for human factors simulation in the DOD. We suggest surveying R&D to project the impacts of the above on a) simulation languages, b) realtime simulations, and c) realtime event driven simulation.

Payoffs: Very high payoffs - millions in potential savings and cost avoidance due to poorly integrated system testing.

#2. Problem: Good simulations for human factors exist as well as complex but acceptable languages. They are, however, too specialized for use by the military end-users.

Approach: R&D is needed to develop user-friendly front ends to assist both language use and to define problems for human factors simulation, also to "front end" existing models. The intent and need is to escape from the "high priest" phenomena surrounding contractor delivered models that repeatedly costs the military for each use of a previously developed tool.

Payoff: High to medium, depending on the scope and contrast value of the model example - the TRW SREM model for air defense.

0084D

MANNED SYSTEM MODELING SUBTAG

7 MAY 1985

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ATTACHMENT L.2

Army Aircrew/Aircraft Integration Program

AEROMECHANICS LABORATORY

RESEARCH AND TECHNOLOGY LABORATORIES

AH 76 M

A^3I

ARMY AIRCREW/AIRCRAFT INTEGRATION PROGRAM

HARTZELL JAN 85

LIFE SCIENCES

AMES RESEARCH CENTER

AH 76 M

HISTORY/BACKGROUND

SPRING 1982	DR. SCULLEY ASA RDA MEETING
AUGUST 1983	LETTER LTG. MOORE TO ASA RDA: AL HAS INITIATED PROGRAM IN PREDICTIVE METHODOLOGY WITH NASA
SEPTEMBER 1983	GUIDANCE COMMITTEE WORKSHOP

Experts in:

- Mathematics and Modeling
- Psychology
- Simulation/Training
- Engineering
- Automated Systems
- Programmatic

AH 76 M

HISTORY / BACKGROUND (Continued)

GUIDANCE COMMITTEE WORKSHOP

One and a Half Day Army Briefings:

– TRADOC, AMAA, LHX, MMI, Simulation, Training Systems/Devices

FOCUS

– Single Crew, High Performance Night-Adverse Weather NOE Helicopter of the Year 2000

AEROMECHANICS LABORATORY

RESEARCH AND TECHNOLOGY LABORATORIES

NASA

AH 76 M

BACKGROUND/HISTORY (continued)

GUIDANCE COMMITTEE WORKSHOP

KEY MESSAGES

1) COCKPIT DEVELOPMENT AND TRAINING SYSTEM DEVELOPMENT ARE SYNERGISTIC

2) VEHICLE/SYSTEM DESIGN SHOULD BE DRIVEN BY AIRCREW REQUIREMENTS

3) MINIMIZING DEVELOPMENT COST, RISK, AND TIME REQUIRES PREDICTIVE MODELS

LIFE SCIENCES

AMES RESEARCH CENTER

AEROMECHANICS LABORATORY

RESEARCH AND TECHNOLOGY LABORATORIES

NASA

AH 76 M

A^3I

GOAL; PROVIDE PRODUCTS AND SERVICES TO BE USED BY PLANNERS AND DESIGNERS OF COCKPITS AND TRAINING SYSTEMS FOR ADVANCED TECHNOLOGY ARMY HELICOPTERS TO AID IN PRODUCING COST AND PERFORMANCE–EFFECTIVE MAN-MACHINE SYSTEMS

LIFE SCIENCES

AMES RESEARCH CENTER

AEROMECHANICS LABORATORY

RESEARCH AND TECHNOLOGY LABORATORIES

AH 76 M

A^3I

OBJECTIVES: DEVELOP AND DISSEMINATE INTERACTIVE/GRAPHIC COMPUTATIONAL TOOLS INCORPORATING MODELS, GUIDELINES, AND PRINCIPLES OF RATIONAL MAN-MACHINE AND INSTRUCTIONAL SYSTEM DESIGN THROUGH:

* DEVELOPMENT OF AUTOMATED TASK/MISSION ANALYSIS METHODOLOGY
* DEVELOPMENT AND INTEGRATION OF ANALYTICAL HUMAN MODEL BASED DESIGN AND EVALUATION METHODOLOGIES
* INTEGRATION OF INSTRUCTIONAL AND COCKPIT SYSTEM DESIGN PROCESSES AND AIRCRAFT SYSTEM-MISSION SCENARIOS
* TRANSPARENT ACCESS TO A SPECTRUM OF COMPUTING RESOURCES, BOTH SYMBOLIC AND NUMERIC
* PROVIDING A COMMON WORKING ENVIRONMENT AND "LANGUAGE" TO SUPPORT COLLABORATION AMONG MAN-MACHINE SYSTEM DEVELOPMENT DISCIPLINES

LIFE SCIENCES

AMES RESEARCH CENTER

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APPROACH

- o CONTRACTS AND GRANTS

- o USE OF: –WORLD CLASS ORGANIZATIONS AND PERSONNEL
  - –GOCO FACILITIES
    - RIACS, JPL
  - – IN HOUSE RESOURCES
    - ASHFRD
    - ISO
    - FSD
  - – UNIVERSITIES

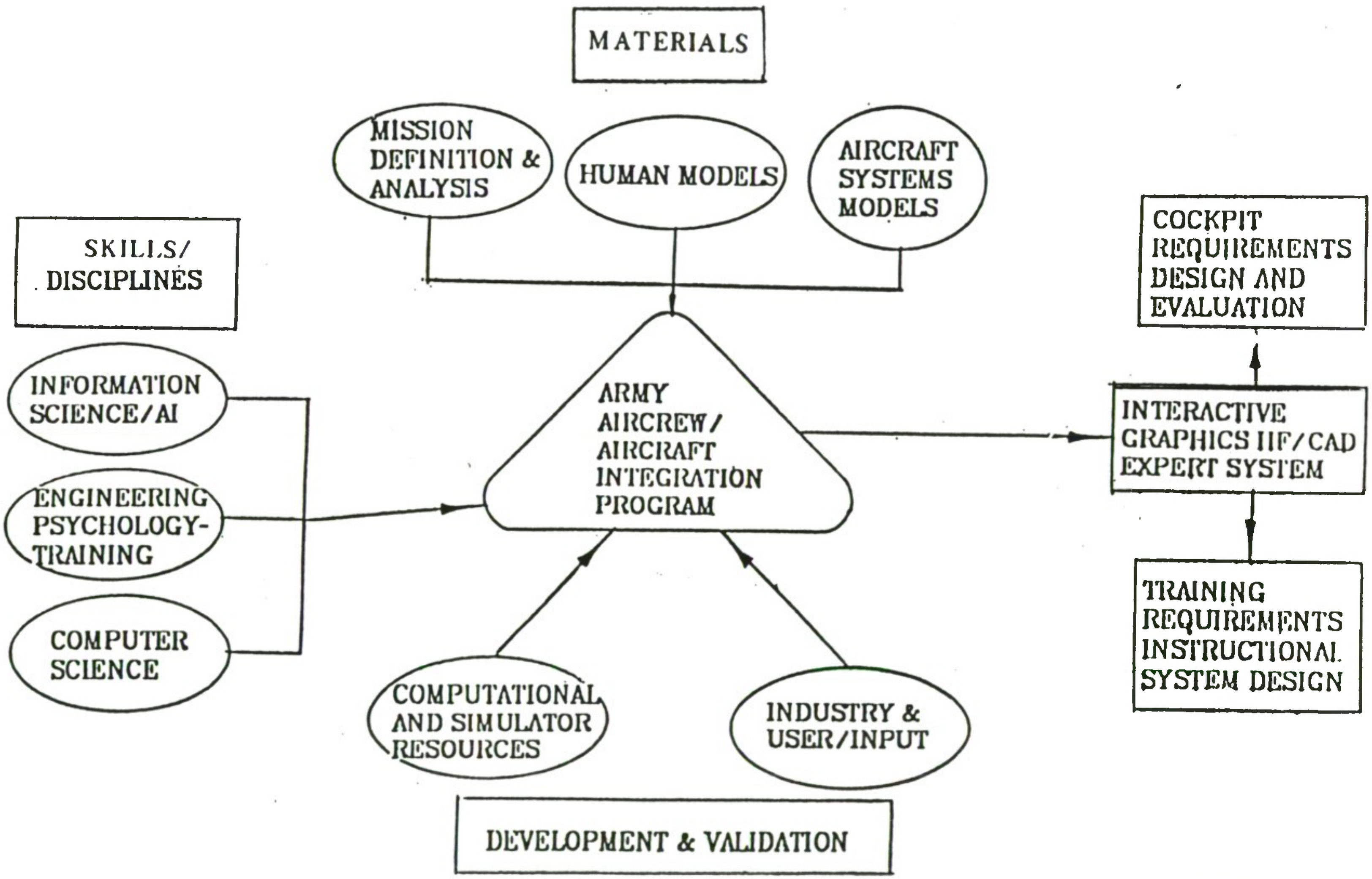
AH 76 M

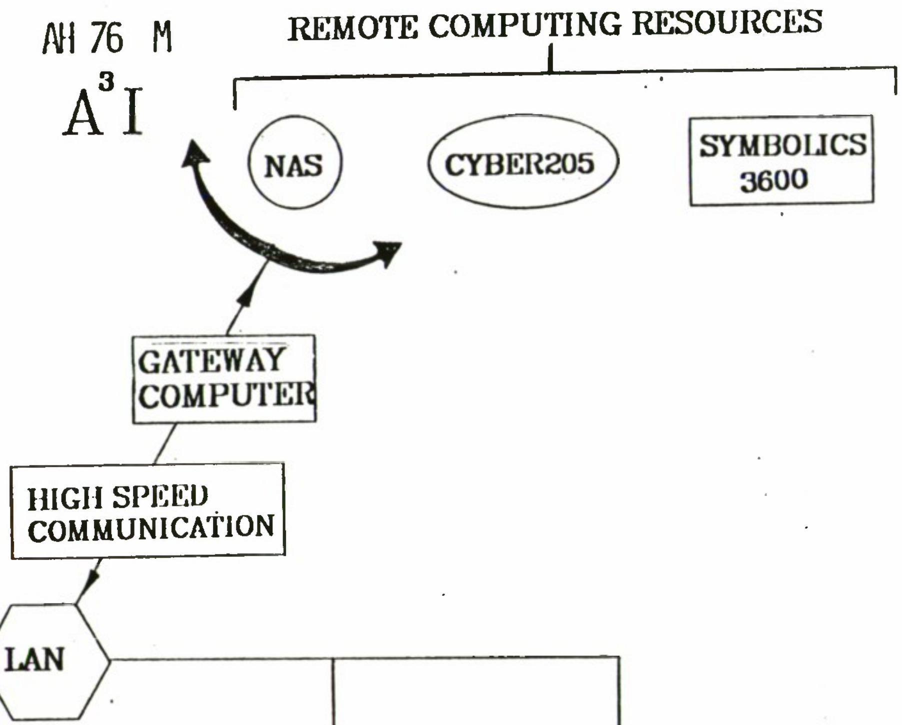
APPROACH (continued)

- USE EXISTING ANALYTIC STRUCTURES AND MODELS
- USE OF RAPID PROTOTYPING TECHNIQUES
- USE COMPUTATIONAL TOOLS TO DEVELOP HF CAD SYSTEM
- PRODUCE TESTABLE/USABLE PRODUCTS THROUGHOUT PROGRAM
- TRANSITION TO 6.3 PRODUCT DEVELOPMENT

AI 76 M

A^3I


MATERIALS
MISSION DEFINITION & ANALYSIS
HUMAN MODELS
AIRCRAFT SYSTEMS MODELS
SKILLS/ DISCIPLINES
INFORMATION SCIENCE/AI
ENGINEERING PSYCHOLOGY-TRAINING
COMPUTER SCIENCE
ARMY AIRCREW/ AIRCRAFT INTEGRATION PROGRAM
COCKPIT REQUIREMENTS DESIGN AND EVALUATION
INTERACTIVE GRAPHICS HF/CAD EXPERT SYSTEM
TRAINING REQUIREMENTS INSTRUCTIONAL SYSTEM DESIGN
COMPUTATIONAL AND SIMULATOR RESOURCES
INDUSTRY & USER/INPUT
DEVELOPMENT & VALIDATION



KEY:

INTERACTIVE MODEL
CALCULATING REQUIRES ACCESS
TO A SPECTRUM OF LOCAL
AND REMOTE COMPUTING RESOURCES

A^3I WORKSTATION

LOCAL COMPUTING RESOURCES

ATTACHMENT M

Sustained/Continuous Operations -- Report, Attendee List,
Draft Charter, Briefings

DEPARTMENT OF THE ARMY
WALTER REED ARMY INSTITUTE OF RESEARCH
WALTER REED ARMY MEDICAL CENTER
WASHINGTON, D.C. 20307

IN REPLY REFER TO:

SGRD-UWI-C 3 June 1985

SUBJECT: Minutes of the first meeting of the Sustained/Continuous Operations SUB TAG: 7 May 1985

Department of Defense
Human Factors Engineering
Technical Advisory Group

1. On 6 Nov 84, at the 13th Meeting of the DOD HFE TAG, Dr. Gerald P. Krueger proposed to the DOD HFE TAG Operating Board that a SUB TAG/Interest Group be formed on the topic of Sustained/Continuous Operations. The proposal was endorsed enthusiastically. It was determined that 1) we had to hold a meeting or two with tri-service participation; 2) we had to develop and submit an appropriate mailing list of interested parties; and 3) we had to develop a charter and submit it to the DOD HFE TAG Executive Committee with our request for recognition as a SUB TAG.

2. The Sustained/Continuous Operations Interest Group formed its nucleus around a group of researchers who met at Toronto in August 84 for an Amer. Psych. Assoc. symposium and a military workshop on these topics.

A comprehensive mailing list of those actively involved in tri-service RDT&E or management of sustained operations matters was developed (Incl 1). Thirty-One participants held the first meeting of the Interest Group the afternoon of 7 May 85 in conjunction with the 14th meeting of the DOD HFE TAG in San Antonio, Texas (agenda as Incl 2 and attendance list as Incl 3). A charter was drawn up (Incl 4), voted upon by the attendees, and on the evening of 7 May it was submitted to the Operating Board and the Executive Committee (Incl 5).

The Executive Committee approved the formation of the Sustained/Continuous Operations SUB TAG during the 14th DOD HFE TAG meeting.

3. At the 7 May 85 meeting of the Sustained/Continuous Operations Interest Group, Dr. Carl Englund of Navy Health Research Center and Dr. Gerald Krueger of the Walter Reed Army Institute of Research handed out copies of the 101 page special section of the Feb 85 issue of the journal Behavior Research Methods, Instruments & Computers. This special section entitled

"Methodological Approaches to the Study of Sustained Work-Sustained Operations" (Incl 6) contains 13 articles resulting from the August 84 Toronto meetings.

4. Krueger handed out copies of Walter Reed's Annotated Bibliography entitled "Human Performance in Continuous/Sustained Operations and the Demands of Extended Work/Rest Schedules" (Incl 7), which he produced specifically for the kick-off meeting of the Interest Group. The document contains 399 citations and abstracts on Sustained Operations.

Each member of the Sustained and Continuous Operations SUB TAG mailing list will be mailed a copy of the bibliography, during the summer 85 when more copies are obtained from the printers. Additional copies will be available from Krueger at Walter Reed upon request. Most of the documents referenced within are easily obtained through either the Defense Technical Information Center (DTIC) or from the National Technical Information Service (NTIS).

Krueger also announced that Walter Reed is maintaining a working Sustained Operations document repository in file cabinets. Without intending to get into an extensive photocopy business, Walter Reed offers to make available select copies of hard-to-get documents from the contents of the repository to any member of the DOD HFE TAG.

Krueger also requests that interested parties send copies of additional documents you think should be included in such a reference resource.

5. MAJ Roger Stallard, of the Army's Soldier Support Center, handed out copies of the Army Field Manual FM-22-9 "Soldier Performance in Continuous Operations" (Incl 8). Request additional copies from The US Army Adjutant General Publications Center, 2800 Eastern Boulevard, Baltimore, MD 21220.

6. There was some discussion regarding how to define Sustained/Continuous Operations. Admitting that the group will likely wrestle with definitions for some time, Incl 9 summarizes some of the major differences in terminology.

7. By charter, the membership of the Sustained/Continuous Operations SUB TAG agreed to select an Operating Board composed of two representatives from each participating US military service. Several of the initial members of the Operating Board have already been determined through service caucuses. They are:

Army: LTC Gerald P. Krueger, PhD
Walter Reed Army Institute of Research

Dr. Jan Brecht
US Army Research Institute for the Behavioral and Social Sciences

Navy: Dr. Carl E. Englund
US Navy Health Research Center

Air Force: Dr. William F. Storm
US Air Force School of Aerospace Medicine

8. Two ex-officio members were also named at the meeting:

Dr. Robert G. Angus
Canadian Defence and Civil Institute of Environmental Medicine

Dr. David F. Dinges
The Institute of Pennsylvania Hospital & University of Pennsylvania

9. LTC Gerald Krueger was approved as the first chairman and he will serve in that capacity until the Spring of 87 when the chairmanship will rotate to a member of another military service.

10. Dr. Krueger offered a skeleton Two Year Sustained Operations Plan for the SUB TAG's consideration (Incl 10). A call for volunteers to serve on the 2-year planning committee was made at the meeting. If others wish to volunteer to participate with the committee they may do so by calling LTC Krueger at (301) 427-5521 or Autovon 291-5521.

11. Short formal presentations were made on various military and civilian laboratories involved in Sustained Operations Research programs. Summaries of several of these presentations are enclosed as Incls 11-15.

12. The next meeting of the Sustained/Continuous Operations SUB TAG is to be held from 0830-1300 hrs. on 3 Oct 85 in conjunction with the Human Factors Society Convention in Baltimore, MD. A good chunk of the time allotted for that meeting will involve work of the 2-year planning committee. More information concerning the plans for that meeting will be distributed later.

Gerald P. Krueger

15 Incl
as

Gerald P. Krueger, Ph.D.
LTC, US Army
Chairman, SUB TAG on
Sustained/Continuous Ops

DOD HFE TAG

SUS OPS SUB TAG Initial Directory/Mailing List -3 June 1985

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Dr. Laverne C. Johnson Dr. Paul Naitoh Naval Health Research Center P.O. Box 85122 San Diego, CA 92138-9174	
Dr. James A. Hodgdon Environmental Physiology Dept. Naval Health Research Center P.O. Box 85122 San Diego, CA 92138-9174	(Minutes Only)
CAPT Robert J. Biersner (Code 40-1), Bldg 142 US Naval Medical R&D Command Bethesda, MD 20814	(Minutes Only)
CAPT James O. Houghton, MC (Code 404) US Naval Medical R&D Command Naval Med Ctr, Nat'l Capital Region Bethesda, MD 20814-5044	(202) 295-1525 AV:295-1525 (Minutes only)
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Meeting Agenda - 7 May 1985
Sustained/Continuous Operations SUB TAG

Introductions and Mailing List	Dr. G. Krueger
Background	Dr. G. Krueger
DOD HFE TAG (Description & History)	
Sustained Ops Sub TAG (Draft Charter)	
Special Issues J. Beh Res Inst & Comp.	Dr. C. Englund
SUS OPS Document Repository & Biblio.	Dr. G. Krueger
Sustained/Continuous Operations A matter of Definition (Discussion)	Dr. G. Krueger
DOD Lab Programs in Sustained Operations	
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USAF School of Aerospace Medicine	Dr. W. Storm
Army P^2NBC^2 Program	Mr. R. Jarboe
Walter Reed Army Institute of Res.	Dr. G. Krueger
US Army Res Inst of Environ. Med.	Dr. J. Vogel
Canadian Programs in Sustained Operations	
Defence Civil Inst. of Environ. Med.	Dr. R. Angus
Non Defense Laboratory Programs	
Ins PA Hosp. Unit for Exp Psychiatry	Dr. D. Dinges
USCG Search & Rescue Ops -DOT	Mr. J. Royal
Two-Year Plan - Committee Formulation	Dr. G. Krueger
Plans for Next Meeting - Fall 85	Dr. G. Krueger

Incl 2

Attendance Roster 7 May 1985
SUSTAINED/CONTINUOUS OPERATIONS - Interest Group

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James A. Vogel	US Army Research Institute of Environmental Medicine
Ralph L. Jarboe	US Army Armor & Engineer Board
Roger Stallard	US Army Soldier Support Center
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Joseph I. Peters	Science Applications International
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Heidi M. Fiedler	Naval Underwater Systems Center
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Mike Frazier	Kirtland Air Force Base
A. David Mangelsdorff	US Army Academy of Health Sciences
William F. Storm	USAF School of Aerospace Medicine
Alan S. Gevins	EEG Systems Laboratory
Loren P. Wurzman	US Army Research Institute
Norman E. Lane	Essex Corp
Herbert Cheesman	Kelly Air Force Base
Larry Shadow	Hill Air Force Base

Incl 3

Attendance - Sustained/Continuous Operations - 7 May 85 cont'd

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Michael L. Moroze	HQ, Air Force Logistics Command
Matilda Reeder	US Army Research Institute
Michael Pianka	Naval Air Test Center
James C. Geddie	US Army Human Engineering Lab
Douglas Miller	HQ, Air Force Systems Command
J.M. Joel	USAF Electronic Systems Division
Daniel J. Mullaney	Veterans Administration Med Ctr
Gary B. Reid	USAF Human Engineering Div/AMRL
Cyrus D. Crites	Test Group, Edwards Air Force Base

Charter
Sustained/Continuous Operations
Technical Advisory Sub Group of the DOD HFE TAG

GOALS

Provide a mechanism for the exchange of technical information for application of Research, Development, Test and Evaluation (RDT&E) methods and technologies as they apply to sustained/continuous operations. To provide input to DOD decision makers and doctrine developers on sustained/continuous operations issues.

Enhance mid-management and working level coordination among Government agencies involved in RDT&E of sustained/continuous operations to make possible the application of the best methodologies and technologies for study of the topic.

Identify human factors technology gaps and requirements for advancement in the state-of-knowledge relevant to sustained/continuous operations.

Encourage and sponsor in-depth technical interaction on the topical areas of: human performance during sustained/continuous work, various work/rest schedules, circadian rhythms, sleep/rest management in military operations.

Assist as required in the preparation and coordination of triservice documents such as Technology Coordinating Papers and Topical Reviews on Sustained/Continuous Operations.

SCOPE

The scope of activities of this group shall include the exchange of information, the working level coordination and the identification of requirements for all technical areas which are applicable to improving equipment operator performance and manpower utilization during sustained/continuous military operations.

By sustained/continuous operations is meant any work schedule that demands steady work productivity during a course of time that goes beyond a "normal" duty cycle and usually involves the onset of fatigue and/or some sleep deprivation.

Incl 4

TOPICAL AREAS

The SUBTAG will address a variety of human factors variables that affect performance in sustained/continuous operations, particularly in the operation of equipment and military systems. The general topics of concern to the SUBTAG include, but are not limited to:

1. Work/rest schedules - periods of time: work to rest ratios.

2. Circadian rhythmicity - biological rhythms as they vary with respect to time.

3. Alertness and Sleep deprivation - adequate amounts of sleep essential for alertness.

4. Sleep discipline - strategies used to insure proper rest, eg. taking naps.

5. Fatigue: a) physiological decreases in performance over time and b) psychological state: feelings of tiredness, change in motivation, mood, affect, activation, decrease in cognitive-mental activities.

6. Pharmacological intervention - use of drugs to enhance or sustain performance.

7. Rapid deployment demands - extended operations, translocation disruptions, eg. jet lag.

8. Sustained performance with unique equipment systems (eg. electro-optical sighting devices, chemical protective clothing, high performance aircraft).

9. Sustained performance in unique environments (eg. heat, cold, altitude, space).

SUBGROUP COMPOSITION

The composition of the sustained/continuous operations subgroup will be consistent with the policies of the DOD HFE TAG.

Membership in the SUBTAG is open to US Government employees, members of academia, private and industrial research organizations and other interested parties whose work involves them in topics of sustained/continuous operations. Participation of members of US Allied Military Forces is encouraged subject to individual approval by the Office of the Undersecretary of Defense for Research and Engineering (OUSDR&E), sponsor of the DOD HFE TAG.

Members of the SUBTAG are encouraged to participate in all SUBTAG meetings and activities. (However, although SUBTAG membership per se is rather open, under DOD HFE TAG policy, only US Government employees are permitted to participate in the full DOD HFE TAG meetings, unless invited for a specific purpose).

OPERATING BOARD

The SUBTAG Operating Board is responsible for the conduct of SUBTAG business and the implementation of TAG policies. It provides continuity and structure necessary for the organization and planning of efforts pursuant to subgroup goals.

The SUBTAG Operating Board shall be composed of two representatives from each participating US military service. These representatives must have technical backgrounds in the areas of sustained/continuous operations. It is intended that the two board members from each service represent a combination of responsitbilities for research/development and implementation-management of sustained/continuous operations technologies within their respective service.

SUBTAG Board members may be selected by service caucus or be nominated by their respective service.

CONDUCT OF BUSINESS

Meetings of the Sustained/Continuous Operations SUBTAG will be held semi-annually; one meeting must be held in conjunction with a semi-annual DOD HFE TAG meeting.

SUBTAG Chairmanship will rotate among represented services biennally, in odd-numbered years beginning in 1985. Chair-select will be determined by Operating Board caucus.

Additional SUBTAG officers required (eg. treasurer, secretary) will be selected by majority vote.

All charges or requests for services of the SUBTAG will be received through the Chairman for action by the SUBTAG Operating Board.

All responses from the SUBTAG will be delivered by the Chairman, or his/her designated representative, as defined through majority opinion.

Minutes of meetings will be recorded, reviewed and transmitted by the SUBTAG Chairman in accordance with policies of the DOD HFE TAG.

The SUBTAG Operating Board will receive and place priorities upon problems to be addressed by the SUBTAG. Where appropriate, Working Groups will be established for addressing particular problems.

Working Groups will be chaired by a member of the Operating Board. Membership of Working Groups, will not be restricted to employees of the Government, and will be nominated by its Chairman for approval by a majority of the Operating Board. Working Groups will develop plans on a milestone basis, and will provide reports of progress at least annually.

Presenters at meetings are expected to submit a copy of their presentations and hardcopies of their visual materials to the SUBTAG Chairman for inclusion in the meeting Minutes.

DEPARTMENT OF THE ARMY
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IN REPLY REFER TO:

SGRD-UWI-C 7 May 1985

SUBJECT: Appeal for Recognition and Acceptance of Continuous-Sustained Operations Interest Group as a SUB TAG of the DOD HFE TAG.

Paul M. Linton,
Chairman of the Executive Committee,
Department of Defense Human Factors Engineering
Technical Advisory Group

1. On 6 Nov 84, at the 13th meeting of the DOD HFE TAG, MAJ Gerald Krueger of the Walter Reed Army Institute of Research proposed to the DOD HFE TAG Operating Board that we establish an Interest Group on the topic of Continuous/Sustained Operations. The Board enthusiastically approved of the idea.

2. Since that time, we: a) formulated our Interest Group; b) established a comprehensive tri-service mailing list of those involved in the RDT&E of Continuous/Sustained Operations (Incl 1); c) conducted our first formal tri-service meeting at the 14th DOD HFE TAG meeting on 7 May 85 (agenda as Incl 2); and e) produced an annotated bibliography on our subject matter (Incl 3).

3. We submit our proposed charter (Incl 4) and hereby request to be recognized as a full-fledged SUB TAG of the DOD HFE TAG. The title of our SUB TAG will be Continuous/Sustained Operations. Our chairman for the first two year period will be Dr. Gerald P. Krueger of the US Army.

4 Incl as

Gerald P. Krueger
Gerald P. Krueger, Ph. D.
MAJOR (P), USA
Chairman, Continuous-Sustained Operations Group

Incl 5

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Department of Behavioral Biology

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Joseph B. Sidowski, Editor
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(continued on inside back cover)

Incl 6

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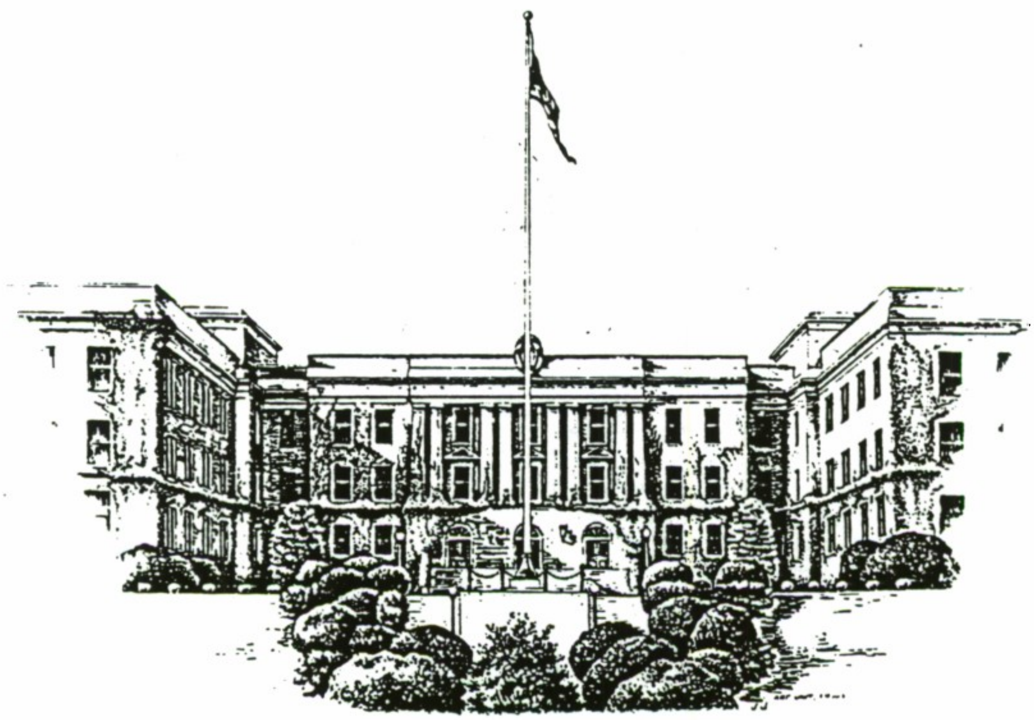
(continued on back cover)

Human Performance in Continuous/Sustained Operations and the Demands of Extended Work/Rest Schedules: An Annotated Bibliography



DIVISION OF NEUROPSYCHIATRY

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Continuous Work	Sustained Operations	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
The performance of workers under conditions of sustained or continuous work is a particularly important topic to the military services. Available research data on the topic are scattered throughout diverse printed sources, many of which are difficult to locate. This annotated bibliography lists 399 references containing research data, conceptual position papers and different methodological approaches to studying human performance in continuous/sustained operations and extended work/rest schedules. The time frame covered in the references is from 1940 to 1985.

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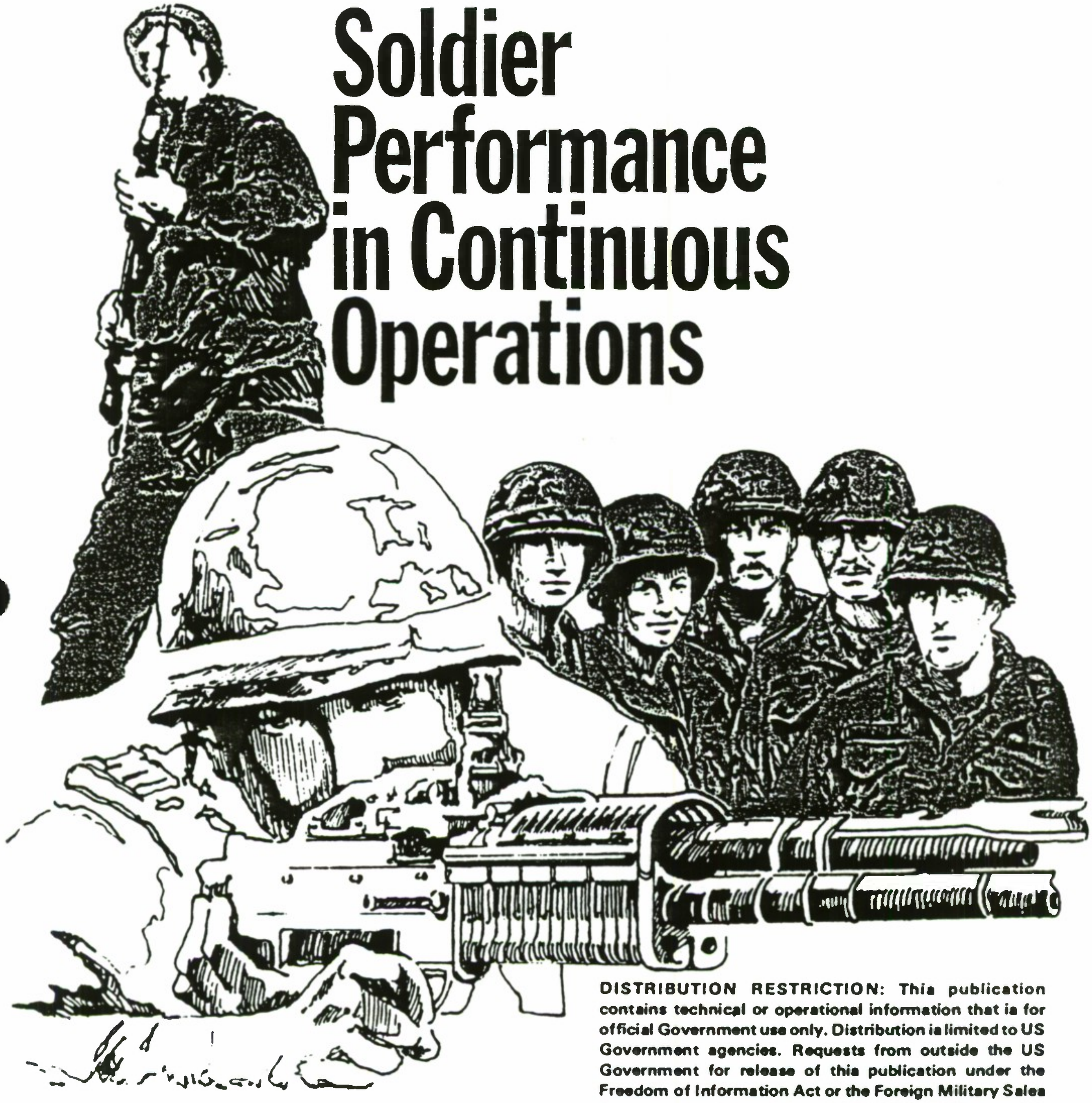
FM 22-9

Soldier Performance in Continuous Operations



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DECEMBER 1983

Incl 8

FIELD MANUAL
No. 22-9

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 8 December 1983

Soldier Performance in Continuous Operations

CONTENTS

Continuous/Sustained Operations

A Matter of Definition

Dictionary

Continuous: extending or prolonging without interruption or cessation; unceasing.

Sustained: to keep in existence; maintain; to endure or withstand, bear up under; to hold up.

Army FM 22-9 (1983)

Sustained Operations: The same soldiers and small units engage in contiuous operations with no opportunity for the unit to stand down and very little opportunity for soldiers to catch more than a few minutes of sleep.

Continuous Operations: "Continuous operations" do not necessarily involve "sustained operations" if sufficient units or individuals within units are available to allow everyone to get adequate rest.

Morgan Mgmt Sys (1984) and Harris & O'Hanlon (1972)

Equipment capabilities allow men to perform effectively day and night.

The concept of continuous operations implies that the performance of a field unit can be maintained at a constant level of effectiveness, not only over a 24-hr day, but for many days on end. In the past, military units did engage in sustained operations, but the operations generally were not planned. The key element of the continuous operation is that it is a "command decision."

Englund & Krueger (1985)

Extended Operations - jobs or tasks that proceed continuously with only a short break or breaks, but that operate within a typical shift system for lengthy periods, longer than a normal duty day. The worker knows he/she will be relieved or able to rest.

Sustained operations - planned or unplanned, goal-oriented, nonstop continuous performance/operations without rest or sleep, in which the worker is expected to keep going as long as he/she can.

Incl 9

TWO YEAR SUS OPS PLAN

A. ENHANCE COORDINATION AMONG SUS OPS RESEARCHERS & TESTERS

- Form DOD HFE SUBTAG - May 85
- Document repository available at Walter Reed '85
- Identify additional publication outlets
- Symposium with publishable proceedings

B. SUMMARY PAPERS of the MAJOR ISSUES 1990's & BEYOND

- For DOD - Continuous/Sustained Ops issues for each service:
    1) the problems of performance decrement
    2) recommended countermeasures
- For the Research Community:
    1) statement of research needs
    2) methodology review
    3) tie lab research into field needs

Incl 10

Dr. Carl E. Englund

THE NAVAL HEALTH RESEARCH CENTER
P.O. BOX 85122
SAN DIEGO, CALIFORNIA 92138-9174

MISSION AND FUNCTIONS

The mission of the Naval Health Research Center (NHRC), as assigned by the Secretary of the Navy, and the functions to be performed to accomplish the mission, as assigned by the Commander, Naval Medical Command, are as follows:

MISSION. To support fleet operational readiness through research, development, test, and evaluation on the biomedical and psychological aspects of Navy and Marine Corps personnel health and performance, and to perform such other functions or tasks as may be directed by higher authority.

FUNCTIONS. As directed by the Commander, Naval Medical Command, and exercised through the Commanding Officer, Naval Medical Research and Development Command, Bethesda, Maryland:

a. Conduct occupational health and safety studies in the naval service to: identify environmental hazards in the workplace and aboard ship; assess the impact of potentially harmful agents or conditions on health and performance; determine casual factors in illness and accidents; and to develop cost-effective intervention strategies.

b. Maintain data files of medical and service history information for all naval personnel to: serve as the basis for longitudinal health studies on morbidity, disability, and mortality in relation to demographic, occupational, environmental, psychological, and service history variables; identify health and safety risks to naval personnel; and to assess the impact of chronic disease on performance and retention.

c. Conduct studies on the unique psychological, physiological, and environmental stresses which place demands on performance and biochemical homeostasis of Navy and Marine Corps personnel in operational environments; identify the physical, mental, and emotional requirements for maintenance and enhancement of performance during sustained military operations; and develop supportive programs for augmentation, restoration, and maintenance of physical fitness to enhance military job performance.

d. Conduct research to quantify the physiological and performance effects of occupational and environmental conditions, pharmacological agents, and certain clinical entities which may enhance or impair health and performance in operational settings.

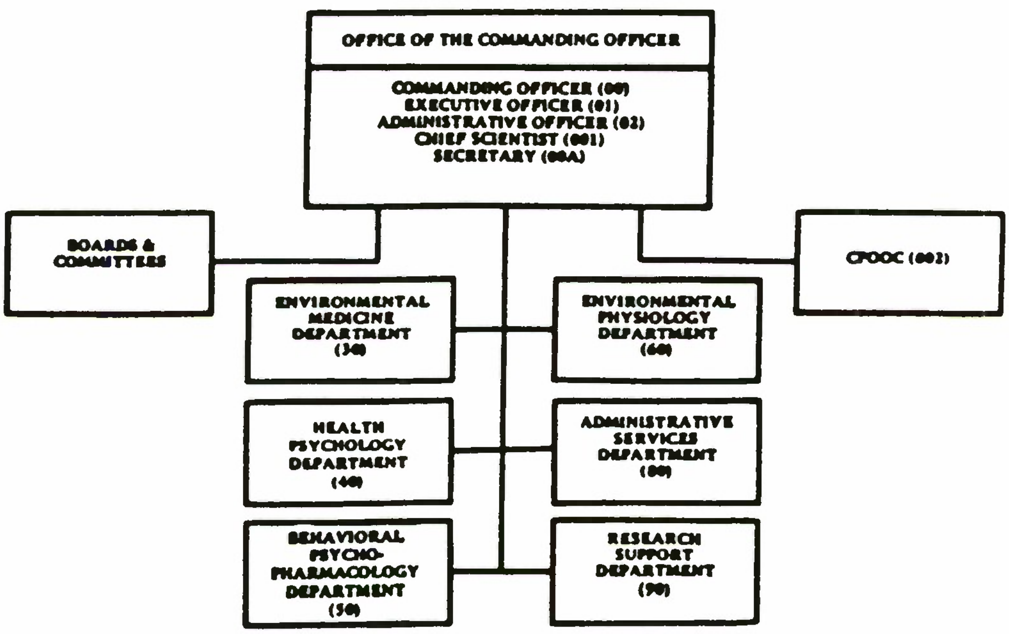
e. Conduct studies on the epidemiology, rapid diagnosis, prevention, and control of infectious agents that adversely impact upon the health and performance of naval service personnel.

f. Conduct studies of naval health care facilities as complex organizations which must coordinate activities of professional and support personnel to provide health care and assess influences on the cost, quality, and effectiveness of health care provision in shipboard and shore facilities; develop information systems relating to Navy medical health care provision for management, clinical, and research purposes.

g. Develop biomedical engineering systems to: improve performance and physical fitness among naval service personnel; augment the quality of health care onboard ship and within naval shore facilities; and enhance casualty assistance and medical records management procedures in combat operations.

h. Provide effective liaison between Navy medical research and development efforts and WESTPAC/Fleet Marine acitivies.

i. Provide or undertake such other appropriate functions as may be authorized or directed by higher authority.



MISSION OF ENVIRONMENTAL PHYSIOLOGY DEPARTMENT (CODE 60)

Head: Paul Naitoh, Ph.D.
DOD HFE TAG member: Carl E. Englund, Ph.D.
Autovon: 933-7394; Commercial (619) 225-7393

Investigates the unique demands placed upon Navy and Marine Corps personnel by their operational environments. Conducts research on psychological, physiological, and environmental stresses as they relate to human performance and impact on biochemical homeostasis. Essential to this work is the identification of the physical, mental and emotional requirements for successful performance during sustained military operations. Included in this research effort is the development of supportive programs for augmentation, restoration, and maintenance of physical fitness and health. Special emphasis is placed upon the implications of sex differences and aging for military job performance.

This Department has continued involvement in the development and evaluation of the biomedical techniques to enhance physical and cognitive performance of Fleet and Marine Corps Forces. Research programs on body composition, physical readiness standards and the Scientific Program of Aerobic and Resistance Training Exercise in the Navy (SPARTEN) have received wide recognition through scientific documentation and pragmatic guidelines. Joint work with the Health Psychology Department will explore the psychosocial mechanisms requisite to maintaining an individual's physical fitness. The Department's neurometric program has been enriched through close interaction with the evoked potential research team at the Naval Submarine Medical Research Laboratory, Groton, CT. This cooperative approach has resulted in standardization of hardware and software for evoked potentials research.

Some research activities in this Department have successfully transitioned to new and more broadly based programs. In bioenergetics, the exploratory phase of Independent Research has been completed and has moved into the U.S. Army supported basic research program on nutrition in exercise. The initial stage of heat tolerance research was completed and resulted in findings that will be pursued further at the Naval Medical Research Institute, Bethesda, MD. Research to evaluate physical and cognitive performances of Marine Corps personnel in sustained operations has been completed. The Sustained Operations technology will now be applied to a tri-service research program on assessing the performance impact of chemical defense measures.

The Department has gained a fully operational second laboratory for exercise physiology, doubling our capability to perform studies related to exercise physiology as well as psychophysiology.

The Research and Technology Work Units are:

1) Human Performance Effectiveness and Physiological Adaptation During Sustained Operations.

Technical Objective: In the Marine Corps, sustained heavy physical work is often required simultaneously with operational demands for high quality mental performance. Requirements for quality performance is repeated, sustained operations are hard to meet because of adverse changes in human effectiveness.

The objective is to see whether behavioral and physiological adaptation occurs as Marines attempt to cope with heavy workloads in repeated sustained operations, and determine optimal recovery sleep to ensure recuperation and resumption of effective combat.

<u>Approach</u>: Marine Corps troops will complete a simulated military mission consisting of two 20-hr sustained operations (SUSOPS) without normal sleep. These two operations will be separated by a 4-hr nap. During the entire 5-day scenario, subjects will complete a battery of psychological tasks and physiological measurements. One-half of the sbjects will experience a physical workload of 30% VO_2 max, while the remaining half will be subjected to 50% VO_2 max workload 30 min each hour. To summarize and communicate new information on the nature of SUSOPS, a joint military conference will be held, and a Marine Corps operation will be observed in the field.

2) The Impact of Chemical Defense Measures on Sustained Military Operations.

<u>Technical Objectives</u>: For Special Warfare and Fleet Marine Forces, sustained work is required simultaneously with sustained cognitive performance. Requirements for high quality physical and cognitive performance are hard to meet due to adverse changes in human effectiveness during sustained operations (SUSOPS). Recently, the need for chemical defense has become the concern of these forces. The performance cost of using individual chemical protective ensembles and/or chemical defense prophylactic drugs needs to be reevaluated in the context of SUSOPS. The objectives of this work unit are (1) to determine impairment of performance and mission effectiveness by ensemble-related thermal burden and by prophylactic drugs, and (2) to evaluate physiological countermeasures, e.g., increasing heat tolerance and cardiovascular fitness to minimize performance degradation.

<u>Approach</u>: During the 5-day scenario simulating a reconnaissance mission, Marine Corps and SEAL volunteers will complete two 20-hr Continuous Work periods (CW1, CW2) in a laboratory. These two CWs will be separated by a 3-hr break period during which time subjects will rest but remain awake. One-half of the subjects will be assigned to the physical work group and march at 2-3 miles/hr on a treadmill for 20 min each hr during the CW periods. One-half of the subjects will be assigned to wear chemical protective ensembles for 3 hrs of each CW episode. In the later phase of this work unit, the effects of chemical defense prophylactic drugs on performance will be examined. Physical fitness and heat tolerance of each subject will be measured to explore the possibility that increased physical fitness and/or heat tolerance may represent physiological methods to enhance performance in SUSOPS when chemical defense is required.

US ARMY ARMOR & ENGINEER BOARD

PURPOSE:

INFORMATION BRIEFING ON P^2NBC^2 PROGRAM FOR FY 85 & 86

M-35

Ralph Jarboe

Incl 12

P^2NBC^2 UPDATE

OUTLINE

- BACKGROUND
- PROGRAM STRATEGY
- TEST STANDARDIZATION
- TEST PROGRAM
- MRDC SUPPORT
- SUMMARY

US ARMY ARMOR & ENGINEER BOARD

$P^2 NBC^2$ – BACKGROUND

- INCREASED SENSITIVITY TO THE CHEMICAL THREAT
- SIMPKIN'S BOOK: HUMAN FACTORS IN MECHANIZED WARFARE
- SRV 72 HOUR TEST
- ARMOR CENTER DESIGNATED CENTER OF EXCELLENCE
- M1 72 HOUR TEST

US ARMY ARMOR & ENGINEER BOARD

P^2NBC^2
DA GUIDANCE

1. ARMOR ENGINEER BOARD TESTING OF SRV HAS UNCOVERED IMPORTANT ISSUES THAT MUST BE EXAMINED IN GREATER DEPTH.

2. THESE ISSUES ARE MAINLY THE PHYSIOLOGICAL AND PSYCHOLOGICAL IMPACT OF NBC AND EXTENDED OPERATIONS ON VEHICLE CREWS.

3. THE ARMOR CENTER SHOULD BECOME A CENTER OF EXCELLENCE TO EVALUATE COMBINED ARMS CREWS AND MEASURE THEIR ABILITY TO FUNCTION UNDER STRESS AND CONFINEMENT.

4. THE ARMOR CENTER SHOULD DESIGN A RDT&E EFFORT TO EVALUATE PSYCHOLOGICAL AND PHYSIOLOGICAL EFFECTS OF NBC AND EXTENDED OPERATIONS ON VEHICLE CREWS. THE PROGRAM SHOULD EXAMINE PROBLEMS AND DEVELOP SOLUTIONS.

5. THE EFFORT WILL REQUIRE INVOLVEMENT OF MEDICAL R&D ELEMENTS.

6. FUNDING UP TO $900K CAN BE PROVIDED BY VCSA, UNLESS (MORE FUNDS) A SEPARATE BUDGET LINE NUMBER IS REQUIRED.

US ARMY ARMOR & ENGINEER BOARD

P^2NBC^2 MISSION

EXAMINE, EXPEDITIOUSLY, PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF NBC AND EXTENDED OPERATIONS ON CREWS.

US ARMY ARMOR & ENGINEER BOARD

P^2NBC^2 GOALS

UNIFY EFFORT
EMPHASIZE SUPPORT OF COMBAT ARMS
PRODUCE PRACTICAL RESULTS
EXCHANGE INFORMATION
WEIGHT MAIN ATTACK
DON'T REINVENT THE WHEEL

US ARMY ARMOR & ENGINEER BOARD

PROGRAM OBJECTIVES

- DETERMINE HUMAN PERFORMANCE LIMITS (P^2)
- DETERMINE WAYS TO INCREASE FIGHTABILITY, HABITABILITY AND SUSTAINMENT OF CURRENT AND FUTURE VEHICLES
- INVESTIGATE COMMAND AND CONTROL TECHNIQUES IN NBC ENVIRONMENT
- ACQUIRE DATA TO VALIDATE/IMPROVE MODELS

US ARMY ARMOR & ENGINEER BOARD

P^2NBC^2 PROGRAM STRATEGY

- SYSTEM APPROACH
- CONCURRENT LITERATURE SEARCH
- TEST-FIX-TEST
- EMPHASIZE DELIVERABLES
- STANDARDIZED TESTING

US ARMY ARMOR & ENGINEER BOARD

FOCUS ON CREW MEMBERS AS SYSTEM COMPONENTS

GIVEN:

- COMBINED ARMS SYSTEMS (TANKS, AFV'S, SP ARTY) CURRENT INVENTORY & PROTOTYPE
- MISSION/TASK REQUIREMENTS
- INTEGRATED BATTLEFIELD CONDITIONS

DETERMINE:

THE LIMITS THAT HUMAN PHYSIOLOGICAL AND PSYCHOLOGICAL CHARACTERISTICS PLACE ON SYSTEM.

THEN:

HOW CAN THESE LIMITS BE OVERCOME?

- DOCTRINE/TRAINING
- ORGANIZATION
- MATERIEL

LITERATURE RESEARCH

- CONTRACTOR SUPPORTED (SATELLITED ON CMLS CONTRACT W/ORI FOR CANE FDTE SUPPORT)
- ALL SOURCES
- CONSOLIDATED BIBLIOGRAPHY
- IMPUTS TO TEST DESIGNS
- EMPHASIS ON EMPIRICAL DATA
- IMPUTS TO "HOW TO FIGHT" GUIDANCE

US ARMY ARMOR & ENGINEER BOARD

TEST–FIX–TEST PROCESS – PRINCIPLES

- SYSTEM SPECIFIC/ITERATIVE/MAXIMUM REALISM
- INTERACT WITH OTHER PROCESSES
  - INFORMATION CLEARINGHOUSE
  - OTHER CENTERS/SCHOOLS
  - SPECIFIC PROGRAMS
- CAPTURE DATA/LEARN WHILE DOING
- MAXIMUM PARTICIPATION BY MED R&D
  AMC COMMANDS & TRADOC OTHER ACTIVITIES/AGENCIES
- RAPIDLY DELIVER USEABLE INFORMATION TO TRAINERS/LEADERS
- STANDARDIZED P^2NBC^2 TEST PROTOCOL A MUST

P^2 NBC^2 PROGRAM - DELIVERABLES

FIELD CIRCULAR GUIDE FOR COMMANDERS:
- PLANNING FACTORS/DECISION CRITERIA
- WAYS TO EXTEND ENDURANCE/PERFORMANCE
- INDICATORS OF PERFORMANCE DEGRADATION
- INSIGHTS ON HOW TO FIGHT

IMPLICATIONS OF TEST RESULTS TO:
- DOCTRINE TRAINING DEVELOPMENT
- COMBAT DEVELOPMENT
- SUPPORTABILITY IMPLICATIONS/INSIGHTS

US ARMY ARMOR & ENGINEER BOARD

P^2NBC^2 STANDARD TEST PROTOCOL

CONTENTS

INTRODUCTION/BACKGROUND/THREAT

METHODOLOGY/TEST DESIGN

ISSUES

ANALYSIS OF ISSUES

INSTRUMENTATION

LOGISTICS AND ADMIN

HUMAN USE PROTOCOL

P^2NBC^2 TEST ISSUES

BASELINE DATA: PERFORMANCE, PHYSIOLOGICAL & PSYCHOLOGICAL EFFECTS

INVESTIGATE: PERFORMANCE PREDICTORS & INDICATORS, COHESION

EXAMINE REMEDIAL MEASURES: TRAINING/DOCTRINE, ORGANIZATION MATERIEL

US ARMY ARMOR & ENGINEER BOARD

TESTING

COMPLETED – M1 72 HOUR TEST (BASELINE)

FY 85

PLANNED
- M1/M1A1 TANK SYSTEMS FIXES
- M2/M113 MECH INF (BASELINE)
- M109 SP HOWITZER (BASELINE)

FY 86

- FIXES FOR MECH INF & FA
- M3 CFV (BASELINE)
- SGT YORK ADG (BASELINE)
- COMBINED OPERATIONS IN CONTAMINATED
- ENVIRONMENT (COCE)

US ARMY ARMOR & ENGINEER BOARD

FY 87 – 91 P^2NBC^2 TESTING

BASELINES: REMAINING SYSTEMS, IE: MORTAR, AD, FA, ENGINEER, COMBAT SERVICE SUPPORT.

FIXES: EXAMINE REMEDIAL MEASURES TO EXTEND THE LIMITS OF PERFORMANCE.

VALIDATION: FOLLOW UP TESTING TO INSURE TRAINING & DOCTRINE/ORGANIZATIONAL/MATERIEL FIXES GENERATE THE DESIRED EFFECT ON PERFORMANCE.

US ARMY MEDICAL RESEARCH AND DEVELOPMENT COMMAND (USAMRDC) SUPPORT TO P^2 NBC^2

- INSURE HEALTH PROTECTION AND MEDICAL REQUIREMENTS ARE MET THROUGHOUT PLANNING AND EXECUTION
- DEVELOP STANDARDIZED TEST PROTOCOL
- DEVELOP PHYSIOLOGICAL AND PSYCHOLOGICAL (P^2) DATA BASES FOR EXTENDED PERFORMANCE PREDICTIONS
- IDENTIFY AND ANALYZE CRITICAL P^2 ELEMENTS CAUSING PERFORMANCE DEGRADATION
- DEVELOP PRACTICAL FIXES TO COUNTER P^2 ELEMENTS CAUSING PERFORMANCE DEGRADATION

Gerald P. Krueger, Ph.D.

Walter Reed Sustained Operations Research Program

In-House Lab/Chamber Studies

6.1/6.2

- 72 Hour Sleep Deprivation Study (Analysis)
- Nap Study - Certainty, Uncertainty (Underway)

Field Studies

6.2/6.3

- P^2NBC^2 Tank Crews in Chem Prot. Clothing (Summer 84)
- Artillery Command Post Vehicle Test at HEL (Fall 84)
- Winter REFORGER, Mech Infantry Cmd & Cont. (Jan 85)
- CANE IIA-Close Cmbt Hvy, Chem & Nuc. 72 hr (Apr 85)
- MP Nuclear Security Ops Test (Summer 85)
- Mech Inf Bde at Nat'l Trng Ctr Ft. Irwin (Summer 85)

Program Development

- APA Symposium & DCIEM Workshop w/Englund (Aug 84)
- Special Issues Behavior Research, Instruments & Computers Journal w/Englund (Feb and Aug 85)
- Annotated Bibliography on Sustained Ops Res (May 85)
- Document Repository on SUS OPS at Walter Reed
- Initiation of DOD HFE TAG Sub Group (May 85)

Incl 13

- DoD HFE TAG Briefing -
"MEASURING HUMAN PERFORMANCE FOR SUSTAINED OPERATIONS"
by
Dr. R.G. Angus - DCIEM - Toronto

This briefing consists of a discussion of the development of an experimental program to study the effects of Sustained Operations conditions on human performance.

The program evolved from a series of studies investigating the effects of stressful conditions, including arctic cold, saturation diving conditions, and physical fatigue, on sleep patterns. In these studies attempts were also made to study psychological performance; and, to that end laboratory behavioural tasks were adapted for field use. A study of the effects of arctic conditions on REM sleep and vigilance performance will be described. Later work was primarily concerned with changes in overt behaviour and involved a recursive cycle of laboratory and field experiments studying variables such as heat and humidity, ship motion, helicopter vibration, and sleep deprivation. A typical study, which investigated the interactive effects of physical exercise and sleep deprivation on a number of different behavioural measures, will be described. These investigations provided useful data regarding the sensitivity of various behavioural tasks and measures, but they also served to illustrate problems of attempting to measure performance under non-laboratory conditions and to emphasize the need to develop non-intrusive indicants of behavioural change. Since experimental manipulations are seldom feasible during military operations psychophysiological indices of alertness and fatigue are now being investigated in both field and laboratory environments. An EEG sleep study conducted under operational conditions will be described.

Current laboratory studies are concerned with the effects of sustained operations conditions on command and control performance. Because the projected scenario involves continuous, high intensity mental work, a laboratory simulation of a command post during sustained battle was developed in which subjects assume the role of operations officers. They are required to handle computerized message traffic and perform related duties during long periods (2-3 days) of sleep loss. Performance is evaluated by monitoring the subjects' message processing ability and their ability to perform objective tasks which are embedded in and distributed around the messages. Several experiments aimed at determining performance limits have been completed, with the essential finding being that the combination of sleep loss and continuous intensive mental work results in much greater decrements in performance than had been expected on the basis of previous sleep deprivation research. Performance efficiency has been shown to drop to 60-70% of normal levels after only a single night of sleep loss, and to unacceptable levels (30-40% of normal) after two nights. Strategies for ameliorating these effects, which include "napping", physical exercise and job rotation, are now being investigated.

The briefing concludes with a discussion of future research goals, especially with regard to providing a more realistic command and control research facility, and to developing research techniques that are appropriate for field studies.

MEASURING HUMAN PERFORMANCE FOR SUSTAINED OPERATIONS

DoD HFE TAG Briefing - 7 May, 1985
by
Bob Angus, DCIEM

A. INTRODUCTION

****** Today's briefing will consist of an overview of a research program being developed to study the effects of sustained operations conditions on human performance. During the presentation I will attempt to provide you with some insight into;

1. Our research methods,

2. The types of problems we have studied in the past, and

3. Our current areas of investigation.

****** Simply stated, the long-term aim of the program is to provide guidelines for;

1. Performance limits, and

2. Rest requirements,

for personnel engaged in 'round-the-clock' operations.

****** Such long-term military operations have become necessary because of:

1. RECENT ADVANCES IN MILITARY TECHNOLOGY (which include improved night vision capabilities, vehicle performance, communications systems, and increased firepower), AND

2. KNOWN WARSAW PACT DOCTRINE (that emphasizes offensive pressure be maintained without respite).

These factors suggest that NATO armies may at some time be forced into fast-paced, high-intensity, sustained operations, against an aggressor whose tactics, and capability, call for the substitution of worn-out units with fresh (2nd echelon) forces, as required.

To counter this, NATO units must perform in a continuous, but effective, manner not only over a single 24-hour day; but for periods in excess of those normally considered possible for a soldier without relief --- which could be from several days to weeks.

****** The success of sustained operations thus requires:

1. That personnel are able to maintain acceptable levels of performance for extended periods;

2. That the work to be done during these extended periods be distributed according to; (1.) The current capabilities of the personnel involved, (2.) the types of tasks that have to be accomplished, and (3.) the conditions under which the tasks must be performed. --- (In other words, the "best" available person must be selected for the job to be done.)

3. Also, that performance schedules be used that maximize the recuperative power of individuals;

4. And, that commanders maintain their ability to monitor their units' performance levels, and make adjustments accordingly.

The major point to be made is that, recommendations for sustained operations require an understanding of the multiple stressors that might influence performance during long periods of work.

Although it might be argued that a great deal of information already exists in the experimental literature concerning the effects of stressful conditions on performance, the findings may not, however, be applicable to sustained operations conditions. The major reason is that:

Much of the research was conducted under sterile laboratory conditions, wherein stressors were studied one-at-a-time for only short periods.

--- In the typical sleep deprivation and performance experiment, for example, subjects remain continuously awake for only a couple of days and their performance is tested once-in-a-while (at specified intervals): In the periods between testing (which may range from a couple of hours to more), nothing much is required of the subjects in terms of demanding work.

(In most studies, subjects simply relax between test sessions; --- they watch T.V., read, study, play cards etc.)

****** Findings from such studies are thus limited, --- and may not provide valid estimates of changes in performance for sustained operations conditions.

To properly estimate the effects of all stressors on performance, research for sustained operations must be done under conditions which approximate the anticipated stressors; --- Otherwise, estimates of performance changes may well be underestimates.

This further implies that at some point sustained operations research must be done in conjunction with "realistic" field exercises; --- Using measures that will not intrude upon the soldiers' assigned duties.

B. EXPERIMENTAL APPROACH

****** Thus, an important goal of our research is to provide measures that can be used in field conditions. To date our research has been concerned with the first step in attaining this goal --- that of providing "reliable" measures of performance.

Our program has, thus far, consisted of a recursive cycle of laboratory and field experiments from which we have gained an understanding of the sensitivity of a number of measures under stressful conditions.

Although many of the methods that I will describe this morning may not be useful during realistic field/training exercises, they do provide good baseline data from which we are developing measures that "will be" appropriate for field use.

****** This approach has led to our current series of laboratory studies in which we are using a battery of psychological, and physiological, measures to investigate the effects of sustained mental work and sleep loss. The goals of this work are:

1. To provide an experimental situation which approximates some activities in a command post during sustained battle;

2. To establish baseline performance limits for long periods of intense work;

3. To determine sleep/rest requirements for individuals to maintain adequate performance during multiple sustained periods of work;

4. And, because our findings must be verified during realistic exercises, techniques are being designed for field use.

Before discussing this current work in detail, I will describe some of our previous work to provide you with an overview of;

1. our experimental approach,

2. some of the techniques we have used to measure performance, and

3. how our techniques and methods have been modified during the cycle of laboratory and field experiments.

****** The studies that have been chosen to highlight our approach include:

1. Two studies on the effects of stressful field conditions ---which include, (1.) arctic cold and (2.) physical exercise --- on both sleep patterns and performance;

2. A laboratory study in which the combined effects of total sleep loss and physical exercise were looked at; and,

3. A study of the sustained operations phase of RV'81 in which the sleep and performance of a small battery of gunners were monitored;

Following this, our on-going Command and Control studies of intensive mental work and sleep loss will be described.

C. KOOL STOOL

****** As stated, our research program evolved from previous work in which we studied the effects of stressful conditions on both sleep patterns and performance. One of the studies was a series of experiments nicknamed KOOL STOOL in which these variables were looked at in troops who worked ****** (the slide shows them on a cross-country hike), and slept ****** in arctic cold (in tents, as shown in the slide).

In one study it was found that sleeping in arctic conditions resulted in a reduction in sleep of about 30%, which was most noticeable in the RAPID EYE MOVEMENT (or, REM) phase of sleep. --- (REM is that stage of sleep during which most dreams occur.)

Although controversy surrounds the functions served by the different sleep stages, there has been concern that loss of REM sleep may lead to decrements in cognitive performance.

Thus, a second study was run in which we attempted to:

1. Verify that sleeping in the cold leads to reductions in REM sleep; and, if so,

2. To determine if changes in cognitive performance would occur.

****** The performance measure chosen was a task of visual vigilance, --- a type of task that is known to be sensitive to the effects of sleep loss. For this particular task subjects were required to detect the onset of a brief flash of light on a white display panel --- (shown on the slide). (Only about 16 signals occurred in each 40 minute test session.)

****** For results, the performance data are presented on the top portion of the slide. Shown are the percent correct detections following 2 nights sleep under normal (or baseline) conditions (when the subjects slept in the warm), and following 8 nights sleep in the cold. (Plus 2 nights of warm sleep again.) --- The changes in REM are shown on the bottom of the slide.

Following sleep in warm conditions the subjects detected about 75% of the signals; But, following the first night in the cold only 50% of the signals were detected. --- This night also produced the greatest reduction in REM sleep, which fell to about 50% the normal amount. (Both performance and REM then improved during the course of the experiment.)

Comparing both results to the overnight temperatures (shown in the middle portion of the slide) we see that all three measures co-varied during the course of the experiment. (As temperature increased and decreased so did performance and REM ... .)

****** In summary, the results provided some support for the notion that reductions in sleep do occur in the cold, which are accompanied by measurable changes in performance. (Providing the index is sensitive.)

D. FASTBALL

****** The next study (nicknamed FASTBALL) was designed to determine the effect of a multi-day physical stressor on sleep patterns and performance.

The rationale for the study was based in the sleep records of the K.S. study. On some days during that experiment the subjects hiked cross-country and their subsequent sleep records showed increased amounts of SLOW WAVE SLEEP. --- SWS is a sleep stage that is sometimes thought to have recuperative value with regard to physical activities, ... following strenuous exercise SWS increases. ---

Thus, in F.B. we attempted to study the role of physical fatigue, on both SWS and performance. --- If SWS increased would performance improve?

The stressor ****** took the form of route marches in which the troops walked for 30-40 km/day for 6 days.

The marches appeared to be stressful for the troops. When they were "fresh" they marched as a "tight" unit (see slide), as the exercise wore on they became more "dispersed" ****** , as you might expect.

To measure this effect objectively the major requirement for the performance task was that it be portable ****** , since subjects were tested at specified intervals during the daily marches.

The task chosen ****** was a 4-choice serial reaction-time task --- a laboratory task known to be sensitive to the effects of sleep loss. For the F.B. field study the experimental equipment was made portable, and the display box was designed so that it could be hand held.

For the task, the lights on the box (slide) flashed one-at-a-time, and the subjects' job was to press a key which corresponded to each light that was flashed. They were required to respond as quickly, and as accurately, as possible. For example, ... (use slide). The major response variable was the number of correct responses made during each minute of the test periods.

The results of the experiment showed that "sleep" remained relatively normal during the period of the exercise, --- except for a small increase in SWS which occurred during the last couple of days of the march.

****** For the performance results, the first data point (slide) is the average number of responses during the last day before the route marches commenced.

For the experimental (or, march days) the number of responses decreased during the first three or four days, then showed an increase --- which corresponded approximately to the increase in SWS. Neither effect, however, was large and the recuperative value of SWS could not be determined.

****** In summary, small changes in performance were monitored using a laboratory task which was adapted for field use. The sleep records also showed small changes. Thus, the measure of performance reflected the rather stable sleep.

E. SLEEP DEPRIVATION AND PHYSICAL EXERCISE

****** In this experiment (this time no nickname), which was done in a laboratory environment, we again looked at physical exercise. However, we were not concerned with it's effect on sleep patterns, but rather if it would have have a positive, or negative, influence on performance during a period of sleep loss.

For this experiment we hoped to:

1. Resolve controversy in the experimental literature regarding the role of exercise during sleep loss; and

2. Determine the sensitivity of a "battery" of cognitive performance measures.

The experiment involved a 64-hour period of sleep loss during which:

1. Half of the subjects exercised ****** every "third" hour by walking on a treadmill (at about 30% of their maximal oxygen uptake);

2. While the other half watched T.V., played cards, studied etc., --- during the same time period;

3. Six weeks later the subjects reversed their roles.

During the two hours between walking (or watching T.V. etc.) the subjects were tested on both physical ****** and psychological ****** abilities. Only the psychological tasks will be discussed today, and these were as follows:

1. ****** Every 3 hours the Ss completed subjective scales pertaining to their feelings of fatigue, sleepiness, and mood states. For these scales the subjects simply checked categories which best described their current state. ****** An example of the Fatigue scale is shown. --- It consists of a list of ten statements ranging from "very lively" -to- "ready to drop", and the subject is asked to "check" whether he feels "better", "same", or "worse" than each of the 10 statements. --- (The other scales were similar.) ---

2. ****** At 6 hour intervals the subjects performed an auditory vigilance task ****** in which they attempted to detect the onset of brief tone signals in bursts of noise. (The task lasted one hour and there were 60 signals, --- it was similar to the task used in K.S., except that the subjects listened.)

3. ****** And, every 12 hours a group tasks (each lasting 10 minutes) was performed which included tests of encoding/decoding, logical reasoning, visual search, computation, and serial reaction time.

Examples of these tasks are:

1. An ENCODE/DECODE task ****** in which 6-digit grid references had to be transformed into 4-letter codes; and, 4-letter codes had to be transformed into 6-digit grid references. The transformations were done using the code elements that were typed across the top of each test page.

2. The LOGICAL REASONING task ****** involved understanding complex sentences in which the subjects were required to indicate whether sentences such as those shown on the slide --- "B DOES NOT FOLLOW A" --- were true, or false, descriptions of the letter pairs ("AB", or "BA") that followed them.

3. For the VISUAL SEARCH task ****** the subjects were required to find pairs of identical letters in a sheet of otherwise random letters.

4. For the COMPUTATION task subjects simply added columns of two digit numbers.

5. The SERIAL REACTION task was the same as the task already described for the F.B. study.

Each of these tasks lasted 10 minutes, and the subjects were instructed to accomplish each task as quickly and as accurately as they could.

RESULTS

1. ****** For results, the first slide shows the subjects' responses on the FATIGUE scale. As the period of sleep loss continued, their scores on the scale decreased. There was no difference between subjects who exercised and those who did not. The other scale data was similar and showed a progressive increase in SLEEPINESS ****** ; and, a decrease in MOOD state ****** .

2. ****** The VIGILANCE data, also showed no difference between the two groups. The slide shows that performance was stable during the first 18 hours of the experiment then it dropped. Following this performance again remained stable for the next 24 hours, when it dropped again.

3. The 10-MINUTE task data showed some similarities to the vigilance data. (No difference between conditions but some evidence of plateaus following 24-hours awake.)

****** ENCODE

****** LOGICAL

****** SEARCH

****** COMPUTATION

****** SERIAL

****** In general the results of the study showed that all of the performance tasks were sensitive to the effect of sleep loss, showing decrements of 10-20% following 24 hours of wakefulness, and decrements of about 30% following 48 hours. The results did not, however, differentiate between the exercise and no-exercise conditions.

F. RV'81

****** With regard to military field operations our work includes a study in which we monitored the cognitive performance ****** and sleep ****** of a small battery of gunners during the "continuous operations" phase of RV'81. (The measures used consisted of some of those already described.)

The most important data from our point of view was to determine the amount of sleep that was obtained during the exercise. The slide ****** shows the duration of each sleep period for each member of the battery during the four day exercise. --- The last column shows the total amount of sleep obtained.

As you can see although their sleep was fragmented into several short "naps", the subjects did manage to get a fair bit (the average was more than 4 hrs. per day). Also, (as might be expected), the data shows an inverse relationship between responsibility/rank and the amount of sleep obtained.

The following slides show that the amount of sleep obtained was adequate to maintain performance --- (at least on the measures we used).

1. FATIGUE ****** The first data point occurs about 24 hrs. after the start of the exercise, and although it is a little lower than what would be expected under normal conditions (indicating some fatigue) --- there is no change in the slope of the line between the subsequent points (the Ss did not get more tired). The other results are similar.

2. SLEEPINESS ******

3. MOOD ******

4. LOGICAL ******

5. EN/DECODE ******

****** In summary the results showed that the subjects averaged about 4 hours sleep per day and that their performance remained stable.

--- The question to be asked of this study, (from our point of view, at least) is whether it adequately reflects work/sleep regimes which might be expected during sustained operations. ---

For our current series of lab studies we have assumed a much worse case. --- In the study I will report now subjects were kept awake, and working (at cognitive tasks), during a period of total sleep loss which lasted more than two days.

G. THE EFFECTS OF SLEEP LOSS AND SUSTAINED MENTAL WORK: IMPLICATIONS FOR COMMAND AND CONTROL PERFORMANCE

INTRODUCTION

****** This experiment was designed to provide baseline data for our studies on the effects of sustained operations conditions on command and control performance. It was specifically concerned with the effects of sleep loss and continuous mental performance.

The reason for conducting the experiment (as noted before), was that findings from previous studies of sleep loss and performance may not provide valid estimates of changes in performance for sustained command and control operations.

****** Recall that the major limitations of these studies are that:

1. Cognitive performance was only measured "once-in-a-while; and,

2. Little in the way of high-demand cognitive activity was required of the subjects between testing ...

--- in other words subjects in these studies are only sleep deprived, they are not stressed with the intense work expected during sustained operations conditions ---

****** In the present experiment we attempted to address this problem by requiring subjects to perform "continuous mental work" in a situation modelled after a command post during sustained battle.

Subjects took the role of "operations duty officers" in a brigade-level command post. Through the use of the computer display terminal (slide), the subjects were sent message information concerning the advance of Canadian Forces during a ground conflict.

The subjects' job was to "access", "read", "understand", "interpret" and "file" the messages they received and, as well, to up-date locations on a map of the battle scene. Embedded in and surrounding this message-processing task were a number of cognitive tests. (Some of which have already been described.) Thus ...

****** Performance was measured by:

1. Monitoring the subjects' message-processing ability; and by,

2. Measuring the subjects' performance on the objective tests that surrounded the messages.

The important point to remember is that subjects were continuously engaged performing a number of cognitive duties which also served to provide a continuous assessment of their abilities.

Using this procedure it was intended that our assessment of performance limits would be maximized by:

1. The continuous high-demand mental workload; and by,

2. The use of cognitive tasks that we knew were sensitive (on the basis of the studies already described) to the effects of sleep loss.

METHOD

Procedure

****** During the experiment the subjects were tested in groups of three, but each was in a separate work-station. The slide shows the experimenters' control area with; (refer to slide)

1. an experimenter

2. three subjects on t.v. monitors

3. three display monitors showing what was on each subject's terminal screen, and

4. the experimenters' control terminals.

The subjects were trained for one day on all the tasks and procedures they would be using; And , as well they were equipped for continuous brainwave, cardiovascular and core temperature recordings, and biochemical samples were taken. (For this presentation, only the psychological performance results will be reported.)

Experimental Design

****** The experiment was 54-hours long and was divided into nine 6-hour Blocks (a sample Block is shown on the slide); and, the same sequence of activities occurred in each 6-hour Block.

Each block contained 4 Sessions of mental work, (slide) and each session was followed by a 10-minute break (slide).

For this presentation I will only describe the results from the "message-processing" task (slide): and, those from tasks which were used in the previous experiments, including (slide):

1. The Self-Report scales for Fatigue, Mood, and Sleepiness (which were presented once per hour);

2. The Serial Reaction task;

3. The Encode/Decode task;

4. The Logical Reasoning task; and,

5. The Auditory Vigilance task.

(How these tasks appeared in the computerized format will also be shown.)

Message Processing. ****** To process the messages the subjects had to first monitor two queues displayed near the top left corner of their terminal display screen (see slide). The values displayed represented the number of PRIORITY 1 and PRIORITY 2 messages waiting to be processed (slide). --- (In this case there are no PR1s, but 6 PR2 messages).

The subjects were instructed to always access the PR1 queue first (if a message was available), regardless of the number in PR2. A message appeared in one of the queues about every 1 1/2 minutes. To access messages, subjects pressed one of two keys on the terminal. (This caused the earliest message in the queue to be presented on the screen.)

For each message displayed, the subjects' task was to read, and understand it well enough to answer a set of questions which followed the message.

The questions required such duties as estimating distances, as shown on the slide (...explain). Other questions required subjects to identify locations, describe unit activities, select units for specific activities, estimate unit arrival times, or ****** to calculate the resource state of various units. --- In this example the subject had to perform a decoding task to find the number of 5/4 ton trucks, (explain...).

Most of the questions required that short phrases be typed on the keyboard, while some ****** required that the scenario map be up-dated. (A LOCSTATE message is shown on the slide.)

Other questions required hand-written summaries that had to be manually filed, and used to answer questions in later messages.

The cognitive tasks included:

Serial Reaction Time (4-choice). The serial reaction task, which was similar to that described before except that the responses were made using four keys on the terminal keyboard ****** , and the stimuli were the numbers of the four Brigade Groups used in the scenario ****** (11, 12, 13, and 14CMBG).

Encode/Decode. ****** The encode/decode task was the same as previously described and the slide shows how it appeared on the computer display terminal, --- in this experiment though, the subjects typed their answers on the terminal keyboard.

Logical Reasoning. ****** The logical reasoning task was also the same as previously described, --- except that the subjects typed T or F.

Auditory Vigilance. ****** And, a similar auditory vigilance task was used.

Self-Report Scales. ****** The scales consisted of the previously described,

1. Fatigue,

2. Sleepiness, and

3. Mood scales.

(****** The slide shows how items from the Fatigue scale were presented --- for each item displayed on the bottom part of the screen, the subject simply rated himself as ... worse, same, or better ... by typing ... 1, 2, or 3.

RESULTS

****** For results, the data from the self-report scales are presented in terms of 6-hour (or, Block) means. The Fatigue, Sleepiness, and Mood results all showed significant changes over the 9 Blocks of the experiment.

Fatigue. As subjects became more fatigued their scores on the scale decreased. A large decrease occurred during the first night awake (after about 18 hours on the task), then a plateau occurred for 24 hours, followed by another decrease during the second night.

Sleepiness. ****** As subjects became more sleepy their scores increased, again with dramatic changes at 18 and 42 hours.

Mood. ****** Scores on the Mood scale showed the same effects. Large changes occurred during the first and second nights, with a plateau in between.

Hour-by-hour Analysis. ****** The scale data was also analysed hour-by-hour. This showed different results for scales completed prior to work Sessions (after a 10-minute rest break), and those completed during work Sessions.

For the Fatigue scale data, the red circles represent data collected at the beginning of work Sessions, while the yellow circles represent data collected during the Sessions. The slide shows that once fatigue began (at about 0300h during the first night) the two curves diverged and did not overlap for the remainder of the experiment.

The same result was shown by all the scale data. The largest effects occurred during the second day (after more than 24 hours awake). --- Then it appears that the subjects were so tired that not even the rest breaks could revive them.

Serial-Reaction (4-choice)

****** For the Serial Reaction task the slide shows the average number of correct responses and errors per minute during each of the 9 Blocks of the experiment. There was a significant decrease in the number of correct responses, with the same plateau effects as were observed in the scale data. (Performance was stable until it dropped during the first night, and then remained stable until the second night, when it dropped again.) There was no change in the number of errors.

Logical Reasoning

****** For Logical Reasoning the slide also shows the numbers of correct responses and errors in each of the 9 Blocks of the experiment, with the change in performance again being due to the decline in correct responses. The data are similar to the previous Serial data. Large decrements occurred during the first and second nights of wakefulness.

Encode/Decode

****** The Encode/Decode data are the same as the previous results. As before the number of errors remained constant, and there were plateaus in the number of correct responses.

Auditory Vigilance

****** The data in this figure are the percentages of correctly detected signals in each of the 9 Blocks. Again, there was a significant decline in performance during the experiment, with similar plateaus to the data already reported.

Message-Processing

****** For the message-processing results, the "points plotted" are the mean message-processing times for each message processing Session. The data represent the amount of time subjects required to read and understand the message information, as well as to answer questions and to file the messages.

These data are similar to those already presented except that the early Sessions showed a learning effect (processing time decreased). The effect of the first night without sleep, however, was to increase the length of time subjects required to process the messages. Performance then plateaued for about 24 hours followed by a very large increase when, as you can see, processing time doubled --- which is a most significant decrement in performance.

DISCUSSION

****** In summary, this experiment was designed to address the limitations of previous studies by providing subjects with a continuous, high-demand environment of tasks that were entirely cognitive in nature and that bore some resemblance to command post tasks.

The results demonstrated that 54 hours of sustained mental work produced greater decrements in performance and mood than would have been expected on the basis of past research. Briefly:

1. Substantial decrements occurred following 18 hours on task (reductions of greater than 30%); and,

2. Generally unacceptable performance occurred following 42 hours (greater than 60% reductions).

The results probably reflect more accurately the kinds of decrements that might be expected during sustained-intensive operations. As well, the data provide us with baseline information for further experiments in which we will be attempting to counter the effects of sleep loss during sustained operations conditions.

H. FUTURE WORK

****** Our future work will concentrate on:

1. Using more realistic command and control tasks with the performance measures more directly embedded into the the operators' duties;

2. Continuing our development of performance measures that are more appropriate for use during field exercises --- these include a combination of (1.) short duration psychological tasks, and (2.) non-invasive physiological measures;

3. The studies themselves will concentrate on ways to counter the effects of sleep loss through the use of different work/rest/sleep schedules.

Our goal, then, is to provide guidelines to assist in the maintenance of adequate performance levels across extended time periods during sustained operations conditions.

Jackson W. Royal

HUMAN FACTORS IN USCG CREW/SMALL BOAT SYSTEMS

The efficiency and effectiveness of the U.S. Coast Guard's Utility Boats (UTBs) and Motor Life Boats (MLBs) and their crews in mission operations are affected by both the operating characteristics of the boats and the performance capabilities of the crews under all types of environmental conditions. For successful mission operations there must be a symbiotic relationship between the crews and their boats, particularly as these conditions become more severe.

The present small boats have evolved from a series of major improvements in areas such as vessel speed, endurance, and sea keeping characteristics as well as in the on board installation of more sophisticated electronic equipment and instrumentation. These improvements in vessel capabilities, however, were based primarily upon operational requirements for the vessel without adequate consideration being given to the ultimate limiting factor in their operation, i.e., the crew.

Coast Guard UTBs and MLBs are forced to operate in an environment that is physically and psychologically demanding to crew members. Factors such as heavy seas, poor visibility, extreme temperatures, insufficient rest between sorties, extended underway times (especially during summer months where 100 hours of work per week are not unheard of), inappropriate or difficult to use equipment, and tension due to being in dangerous situations all contribute to an increase in crew fatigue and a concomitant decrease in crew/boat system safety and effectiveness. In spite of these factors, there is no doubt that in the main small boat crews have fulfilled their mission responsibilities most effectively and, in many cases, outstandingly well in the face of extremely harsh environmental conditions.

In an effort to increase the safety and professionalism of crew/small boat operations, District Commanders have been directed to develop local boat crew utilization programs. In an 11-year period, 22 of 399 accidents reported for small boats identified crew fatigue as a contributing factor. While this may seem like a small number (less than six percent), it is unacceptable and it is quite reasonable to believe that fatigue and stress played a significant role in these and many other accidents, both reported and unreported.

Incl 15

The overall objective of this project is to improve the professionalism and safety of crews and their CG UTBs and MLBs, as crew/boat systems. Based on a study of 41- and 44-foot small boat operations, documentation will be developed which relates crew performance degradation and the development of fatigue to time at sea and other variables such as:

- o Boat Type
- o Geographic Location
- o Mission Type
- o Mission Activity
- o Environmental Conditions
- o Time of Day/Night
- o Pre/Intramission Activity
- o Motion Sickness.

The present research includes a pilot study, performed last December at CG Station Monterey, and four field studies to be performed this summer, during the height of the SAR season. In this research, at least 16 crew members comprising four different SAR crews will be studied.

The specific conditions under which the individual runs will be made are largely beyond experimenter control. The first field study, to be performed at Pt. Allerton Station in Hull, Massachusettes, is designed around four different schedules of 10 at-sea hours per day. During these runs the crew will perform simulated activities related to their various mission responsibilities. These will include searching, towing, firefighting, dewatering, and other SAR activities; various law enforcement operations; and environmental protection/response activities. However, the weather, time of day, and the occurrence of actual SAR cases will affect many of the independent variables for these studies. As these factors influence the operational aspects of the studies, variations will be made in the design in order to approximate a balanced series of studies.

Data analysis will progress as the studies are run in order to assure that the experimental design does, in fact, yield appropriate levels of fatigue and allow for modifications in future field studies.

HUMAN FACTORS
IN
CREW/SMALL BOAT SYSTEMS

OBJECTIVE

- TO OBTAIN SCIENTIFIC DATA RELATING OPERATIONAL AND ENVIRONMENTAL FACTORS TO CREWMEMBER PERFORMANCE IN 41-FOOT UTILITY BOATS (UTB) AND 44-FOOT MOTOR LIFE BOATS (MLB) IN THE EXECUTION OF THEIR ASSIGNED MISSIONS.

- TO PROVIDE DATA RELATING THE EFFECTS OF THESE OPERATIONAL AND ENVIRONMENTAL FACTORS TO EXPECTED PERFORMANCE DECREMENTS, THUS ALLOWING COAST GUARD HEADQUARTERS TO ESTABLISH GUIDELINES FOR THE DEPLOYMENT AND RECALL OF SMALL BOAT CREWS.

- TO PROVIDE RECOMMENDATIONS TO THE PROGRAM MANAGER CONCERNING DUTY SCHEDULES AND WORK-REST CYCLES.

INDEPENDENT VARIABLES

- BOAT TYPE
- SEA STATE
- VISIBILITY
- STATION ACTIVITIES
- MISSION ACTIVITIES
- MISSION DURATION
- MISSION HOURS DISTRIBUTION
- SLEEP/WAKE DISTRIBUTION

DEPENDENT VARIABLES

- HEART RATE
- HEART RATE VARIABILITY
- ENDOGENOUS EYE BLINK DURATION
- BODY TEMPERATURE
- NEAR/FAR VISUAL CONTRAST SENSITIVITY
- CODE SUBSTITUTION
- PATTERN RECOGNITION
- GRAMMATICAL REASONING
- RYTHMIC TAPPING
- SUBJECTIVE RATINGS OF:
  MOOD, MOTION SICKNESS, WORKLOAD, FATIGUE

ATTACHMENT N.1

Tri-Service Human Factors Standardization Steering

Committee -- Minutes of 6 November 1984

Minutes of the Eleventh Meeting of the
Tri-Service Human Factors Standardization Steering Committee (HFSSC)

West Point, NY
6 November 1984

PURPOSE

The eleventh meeting of the HFSSC was convened 0830-1230 hours on 6 Nov 1984 in the Highlands Room of the Thayer Hotel, West Point, NY, in conjunction with the thirteenth meeting of the DoD Human Factors Engineering (HFE) Technical Advisory Group (TAG). The purpose of the meeting was to address the agenda items of Enclosure 1.

ATTENDANCE

Members and Alternates Present:

Mr. Gerald Chaikin, HEL Detachment-MICOM
Mr. Clarence A. Fry, HEL
Dr. John L. Miles, Jr., ARI
MAJ Gerald P. Krueger, WRAIR
Dr. Heber G. Moore, NAVMAT
Mr. Steve A. Heckart, AFAMRL
Mr. William C. Herbert, BMO

Industry Liaison Representatives Present:

Mr. Maurice A. Larue, Jr., AIA
Dr. Julien M. Christensen, HFS

Others Present:

Dr. Eugenia R. Schneider, NWC
CPT Michael L. Moroze, AFSC
Mr. Roger A. Lockwood, USAF Space Div.
Mr. Terry L. Lutz, AFISC
Dr. Richard J. Schiffler, ASD

Members Absent:

Mr. Tom Metzler, AVSCOM
Mr. Larry A. Peterson, HEL
LCDR Larry Dean, NPRDC
Mr. Stephen C. Merriman, NADC
Mr. Robert N. Deem, AFHRL

Industry Liaison Representatives Absent:

Dr. Mark M. Brauer, AIIE
Mr. Wolf J. Hebenstreit, NSIA/EIA

Enclosure 1

DISCUSSION

1. MINUTES OF PREVIOUS MEETING

(Draft minutes of the previous meeting had been mailed to members, industry liaison representatives and other attendees, 20 June 1984. Since no changes were requested, the minutes had been approved 1 October 1984.)

2. ANNOUNCEMENTS

a. Correspondence Summary. - A summary of incoming and outgoing correspondence (Encl 2) was furnished the attendees. No request for copies of non-distributed correspondence was made.

b. Membership Changes. - Mr. Chaikin announced that NARM had discontinued its participation in the TAG, as advised 23 October, and that Mr. Lorge's name would, therefore, be dropped as an industry liaison representative. The current membership list (Encl 3) was distributed.

c. MIL-H-46855B. - Mr. Chaikin stated that a recent discussion with DMSSO disclosed no need to reformat this specification during the next revision unless the revision is so extensive that it would essentially develop into a perceptibly different document. Mr. Heckart questioned if it might be desirable to change to the MIL-STD format anyway, noting that a report had been received indicating reluctance to use MIL-H-46855 as a tasking document because it was not in MIL-STD format. Mr. Chaikin replied that this appeared to be an isolated instance and that a format change could always be considered during the next revision.

d. DARCOM-R 70-9. - Mr. Fry provided a synopsis of this new regulation--Human Factors Engineering During System Development--and provided copies (Encl 4) to the attendees. It was pointed out that the documents which Appendix C of that regulation identify as key HFE inputs are products overseen by the HFSSC.

3. STATUS REPORTS

a. Status of Projects. - Mr. Chaikin furnished the attendees with summaries of scheduled actions, dates and status for current HFAC projects (Incl 5).

b. HFAC-0009. - Dr. Miles provided a summary of the Personnel and Training Tasking Documents/DIDs Engineering Practice Study (EPS) and provided an extract from the draft final report (Encl 6). Approximately 50 data items will be recommended for cancellation and approximately 100 will be recommended for validation/revision/cancellation reviews by the originating agencies. Other recommendations currently being considered include making management of MPT technology within DIDs explicit in the HFAC charter and undertaking an EPS to consolidate primary MPT DIDs and link those DIDs to requirements documents. During a discussion of the coordination and completion process, Mr. Chaikin agreed to send information copies of the EPS report to members and industry liaison representatives when the report is received for coordination. Mr. Lockhart cautioned against drawing system safety H-category DIDs into the

EPS cancellation and review recommendations. Dr. Miles responded that the EPS group did not deal with safety DIDs. Mr. Lockhart stressed the importance of the system safety and HFE program interfaces. At this point, an extended discussion involving safety engineering and HFE, safety DIDs, effects of proposed MIL-STD-963 and related areas transpired with principal participants being Mr. Lockwood, Dr. Miles, and MAJ Lutz. The discussion of this area concluded with agreement that the HFSSC would look to Mr. Lockwood to define any perceived system safety engineering/HFE interface problems, as they apply to the HFAC area, at the next HFSSC meeting.

c. HFAC-0016. - Mr. Metzler was unable to attend this meeting to report on this project which was undertaken to prepare revision "A" to MIL-STD-1294 (Acoustical Noise Limits in Helicopters), transfer the standard from FSC 1520 (Rotary Aircraft) to the HFAC Area, update the standard to include metrication, and prepare two DIDs. Mr. Chaikin noted that phone contact with Mr. Metzler in October disclosed, as result of coordination and review by DOD (probably the DoD Clearance Officer), that the proposed DIDs are being changed, the proposed revision will be recirculated and the project should be complete around Jan 85.

d. HFAC-0019. - Mr. Chaikin reported that Mr. Peterson, who was unable to attend the HFSSC meeting because of schedule conflict with the User/Computer Interaction (UC/I) STAG which he--Mr. Peterson--chairs, had provided the following status summary of the Engineering Practice Study (EPS) for Keypad Design:

> "Coordinated fourth quarter 84 and comments received at coordinating agency. HEL waiting for comment summary in order to do final version of engineering practices study. Status - Slip in completion date from 1st quarter 85 to 2nd quarter 85 expected."

e. HFAC-0020. - See item 3d, above. Mr. Peterson's report on the Keyboard and Function Key EPS stated the following:

> "Contract awarded to Texas A&M in early September after almost three months in procurement. Work is proceeding and draft copy should be ready for Tri-service coordination in 1st quarter FY85. Status - Slipped to coordination date of 1st quarter 85, completion date of 2nd quarter FY85."

f. HFAC-0022. - Mr. Chaikin stated that information copies of MIL-STD-1472C, Notice 2, Human Engineering Design Criteria for Military Systems, Equipment and Facilities, approved 10 May 84, were sent, 26 Sep 84, to members and industry liaison representatives. He recommended that this item, therefore, be dropped from the agenda. The attendees concurred.

g. HFAC-0024. - Mr. Chaikin reported that comments on the coordination draft of MIL-HDBK-XXX, "Human Engineering Guidelines for Management Information Systems," were due at the preparing activity between 15 Oct and 1 November, depending on the latest granted comment extension request. Completion is still scheduled for the 3d quarter of FY85.

h. HFAC-A012. - See item 3c. Mr. Chaikin advised that Mr. Metzler confirmed, by phone, that this effort was completed with issue of MIL-STD-1295A, Human Factors Engineering Design Criteria for Helicopter Cockpit Electro-Optical Display Symbology, dated 26 June 1984. Mr. Chaikin requested that this item be dropped from the agenda and the members and industry liaison representatives agreed.

i. HFAC-A013. - Mr. Chaikin stated that information copies of MIL-STD-1474B, Notice 2, Noise Limits for Army Materiel, dated 16 Apr 84, had been submitted to HFSCC members and industry liaison representatives on 16 Jul 84. He requested that this item be dropped from the agenda and the members and industry liaison representatives agreed.

j. HFAC-F002. - Mr. Herbert reported that proposed MIL-STD-XXXX, Human Factors Engineering and Management for Intercontinental Ballistic Missile Systems, had been circulated for limited coordination and that responses were received from all reviewers but DMSSO and industry. Mr. Larue suggested that a response had not been received from AIA because, to the best of his knowledge, AIA had never been asked to review the draft. Mr. Herbert provided TRW, AFLC, Space Division, AFAMRL, ASD, AMXHE-MI and AMSMI-EDS comments as a single handout (Enclosure 7), with comment originators unidentified. A copy of the letter from HQ, AFSC, which submitted the comments from AFSC product divisions, was also provided (Enclosure 8). This letter recommended that the material be structured into a military handbook, rather than a military standard. Mr. Herbert noted that the use envisioned for the proposed standard primarily involves potential application to the small missile program and that the five data items would be needed. Mr. Chaikin, who had circulated copies of the proposed MIL-STD to HFSSC members and industry liaison representatives, furnished copies of the following:

(1) Involvement in Development of MIL-STD-XXXX. (Enclosure 9)

(2) Letter, DRXHE-MI, dtd 20 Aug 84, subject: Proposed MIL-STD-XXXX, Human Factors Engineering and Management for Intercontinental Ballistic Missile Systems. (Enclosure 10)

(3) Letter, HED, dtd 19 Sep 84, subject: Proposed MIL-STD-XXXX-ICBM. (Enclosure 11)

(4) Letter, AIA, dtd 18 Oct 84. (Enclosure 12)

Mr. Chaikin stated that he was disturbed about the adverse impact that the standard would have on HFAC program initiatives in the areas of metrication, reduction and consolidation of DIDs, use of industry documents, elimination of non-DODISS citations, and duplication of provisions of other documents (MIL-H-46855B), among other concerns. He noted that the compromising of the current accomplishment record, if the standard were adopted, would have a chilling effect on these initiatives and would likely relegate progress in these areas from proactiveness to mere record keeping. He mentioned that a possible solution to the HFAC area's avoidance of this problem might be to put the standard into a product FSC (e.g., 1400) but that such action would likely be inappropriate since the proposed standard is clearly in the HFAC area. Mr. Larue explained AIA's opposition to development of this proposed MIL-STD, as documented in Enclosure 10. Mr. Heckart, in like manner, briefly outlined his negative overview expressed in Enclosure 11. Mr. Fry felt that most material in the proposed standard exists elsewhere. Dr. Schiffler stated that the proposed standard may have utility for BMO but would have little use within ASD. Mr. Chaikin noted that he was concerned that written responses to requests for review of the proposed document, from the standpoint of policy and general considerations rather than detail, all seem to be negative, and asked for recommendations regarding the proposed standard. It was agreed, since the standard is proposed as a limited coordination (USAF) document, that the TAG Air Force Caucus would review the issues and provide a statement to Mr. Chaikin prior to conclusion of the 13th DOD HFE TAG meeting. A statement, (Enclosure 13) provided to Mr. Chaikin at the DOD HFE TAG Operating Board Meeting the night of 6 Nov, did not resolve the issues.

k. MIL-PRIME Update. - Dr. Schiffler provided background and format information regarding the MIL-PRIME initiative, noting that 50 MIL-PRIMEs are involved--five of them in his branch. The latter five documents include Aircraft Display Symbology (completed December 84); Sound Pressure Levels in Aircraft (planned for completion in Apr 85); General Specification for Aircraft Lighting (planned for completion the end of FY85); Human Computer Interface, and Human Engineering. In response to a question by Mr. Chaikin, Dr. Schiffler stated that MIL-S-008806B will be cancelled upon approval of the Sound Pressure Levels in Aircraft document. A copy of that draft MIL-PRIME was circulated among the attendees. Dr. Schiffler advised that a night vision-compatible lighting specification is being prepared. Mr. Fry asked if current planning is focused on eventual elevation of MIL-PRIMEs to MIL-STDs. Dr. Schiffler stated that he didn't know but that a letter could be sent to ASD, specifically asking that question. Finally, he advised Mr. Chaikin that the material on MIL-PRIME contained in the preliminary draft HFAC Program Plan, R4, is satisfactory as written.

l. Task Analysis Update. - Dr. Geddie was unable to attend the HFSSC meeting. Dr. Miles suggested that Dr. Geddie's absence was likely the result of the HFSSC and T&E STAG meeting schedules coinciding. Conflict with the U/CI STAG was also noted as was absence of the AIIE Liaison Representative, Dr. Brauer, who was attending the U/CI STAG meeting. Brief discussion regarding minimizing conflict between HFSSC and other meetings ensued. A survey of attendees, regarding meeting schedule conflict avoidance preference, resulted in the following:

	1st Priority	2nd Priority
Technical Society/Industry:	4	
Test and Evaluation	3	1
Workload	2	
Controls & Displays	1	
User Computer Interaction	1	

Mr. Chaikin submitted these conflict avoidance recommendations to the TAG secretary.

m. ASSP Update. - Dr. Schiffler reported that an ASSP meeting was held at Wright-Patterson AFB, OH, in June 84, that the Air Force presented its MIL-PRIME program including 40 industry comments, that the labs reported on their activities, and that several groups were formed for updating MIL-STD-411, -203 and -250.

4. UNFINISHED BUSINESS

a. MIl-STD-490 Coverage of GAO Target Areas. - Mr. Heckart contacted the preparing activity of MIL-STD-490 to determine status of the HFSSC-proposed changes and reported that the HFSSC recommendations are being kept on file pending proposed revision or change notice action on the standard.

b. HFAC Program Plan, R4. - Mr. Chaikin noted that he had recently mailed copies of the preliminary draft to each member and industry liaison representative, along with a listing of member vs pages-of-interest. He requested that any changes or additions be annotated directly on the draft and that the marked-up pages be submitted to him by the end of the year.

c. User-Computer Interface. - Mr. Chaikin stated that coverage of this item at the last meeting involved the HFSSC's offering the U/CI STAG the "right of first refusal" with regard to generation of any stand-alone military standard covering the U/CI area and that Mr. Peterson had advised the HFSSC that the issue remained open and that he would communicate the HFSSC position to the U/CI STAG. Mr. Chaikin proposed, as result of this exchange beteen the HFSSC and the U/CI STAG, that this item be dropped from the agenda. MAJ Krueger counterproposed that the item remain on the agenda until the next meeting and that continued retention be determined by Mr. Peterson. The members and industry liaison representatives concurred with MAJ Krueger's position.

d. Life Support and Biomedical Factors Coverage. - MAJ Krueger discussed background and general conclusions raised by consideration of this issue and explored options. Mr. Herbert advised, as followup to his visit to Brooks AFB this past June, that the Occupational and Environmental Health Lab (OEHL) of the School of Aerospace Medicine will undertake a review of the BMO document which Mr. Herbert had offered the HFSSC as a possible strawman standard. He stated that the BMO document will be revised on the basis of the OEHL comments. Coordination with HQ, AFSC and the AF Surgeon General is anticipated.
MAJ Krueger stated that he had undertaken a review of each item in the strawman on the basis of application scope and that this review disclosed that much of the MIL-STD-1472 data has more general applicability than for fixed facilities. MAJ Krueger then stated that a key question seems to be whether MIL-STD-1472 (or other standard) should provide coverage on the basis of application generality. Mr. Herbert recalled that the BMO draft was originally for the densepack (or closely spaced basing) application. The next potential application was deep basing. Mobile application is being considered at this time. He also noted that Brooks AFB suggested the possibility of an OSHA type document being used. At that point, MAJ Krueger delineated specific options and felt that the comments from OEHL should be reviewed before recommending final disposition of this issue. Mr. Herbert suggested that the material (Original DD Form 1426, BMO strawman, review, OEHL comments) could be referred to the Tri-service Technical

Group for MIL-STD-1472. MAJ Krueger felt that a lot of information is available and the question as to whether it belongs in MIL-STD-1472 has not been answered. He also suggested that a separate document could be prepared if a group were formed to do so. At this point Dr. Christensen advised that linkage between human performance and environmental effects could produce an unreasonably sized document. Mr. Herbert responded that OEHL will likely be tasked by AFSC to refine the stand-alone document (presumably the BMO strawman). Finally, Dr. Schiffler recommended that two actions be undertaken: (1) Refer to the Tri-Service Technical Group for MIL-STD-1472 those provisions that can be included in that standard and (2) if results of the OEHL review/refinement discloses that the BMO draft is suitable as a stand alone document, the issue can be handled at that time. The members and liaison representatives agreed with this approach. MAJ Krueger stated that he would redline those items in the BMO strawman that he feels may be appropriate for inclusion in MIL-STD-1472 and foward the marked up strawman to Mr. Chaikin for the Tri-Service Technical Group for MIL-STD-1472.

e. PMTC Review of 1472C, para 5.9. - Since Mr. Mahar did not attend the meeting, this item was not discussed.

f. HFSSC Charter Update. - Mr. Chaikin reported that the HFSSC charter, updated to reflect agreements of the last meeting, was forwarded to the TAG Chairman. Copies were furnished to the attendees. (Encl 14).

5. NEW BUSINESS

a. MIL-STD-1567A. - Mr. Chaikin reminded the members and industry liaison representatives that he had sent a letter 14 Aug, furnishing a copy of MIL-STD-1567A, 11 Mar 83, Work Measurement, and asking if the standard should be transferred to the HFAC area. Request for review resulted from a DMSSO inquiry. A tentative negative reply had been provided to the DMSSO HFAC proponent, subject to confirmation at this meeting. The members and industry liaison representatives confirmed the initial reaction--that MIL-STD-1567A should not be considered for transition to the HFAC area.

b. NBC Considerations. - Dr. Miles stated that he had heard that requirements for positive pressure in vehicles may conflict with some human engineering ventilation standards. Mr. Chaikin stated that he has had no problems reported to him locally, that positive pressure systems were being developed and the main problems he has seen involved seals and materials which have been correctable.

c. MIL-STD-963. - Dr. Miles stated that this standard was being recoordinated with suspense around 24 November. He noted that significant changes involved new format DID with no referenced document block and abolition of functional areas in favor of using standardization areas, e.g., DI-HFAC-XXXX. He regards these changes as positive. On the other hand, he expressed some concern that the revised draft fragments things that people are trying to put together, e.g., HE to HFAC, P&T to Acquistion and Logistics, and Manpower to nowhere. No one else at the meeting, other than Dr. Miles, had seen the revised draft. Dr. Miles advised that he understood the recoordination cycle to be 24 Oct - 25 Nov.

d. Fifth Percentile Female in the Workforce. - Mr. Herbert stated that 5.6.1 of MIL-STD-1472 requires accommodation of applicable 5th percentile female dimensions through 95th percentile male dimensions and reviewed compliance problems. He disclosed that he has prepared a letter asking Secretary of the Air Force approval to use this range for design. He asked why design should accommodate the 5th - 95th percentiles, questioned where this range came from and concluded that it is very costly to accommodate females with applicable 5th percentile dimensions. Mr. Herbert stated that he planned to discuss the issue in more detail at the plenary session.

Gerald Chaikin 21 Mar 85

14 Encls
as

GERALD CHAIKIN
Chairman

ATTACHMENT N.2

Tri-Service Human Factors Standardization

Steering Committee -- View Graphs

AGENDA

Twelfth Meeting of the
Tri-Service Human Factors Standardization Steering Committee

1.	Minutes of Previous Meeting	Chaikin
2.	Announcements	
	a. Correspondence Summary	Chaikin
	b. Membership and STAG Schedule Blocks	"
	c. Other	
3.	Status Reports	
	a. Status of Projects	Chaikin
	b. HFAC-0009	Miles/Merriman
	c. HFAC-0016	Metzler
	d. HFAC-0019	Peterson
	e. HFAC-0020	"
	f. HFAC-0024	Chaikin
	g. HFAC-0025	"
	h. HFAC-0026	"
	i. HFAC-0027	"
	j. HFAC-A014	"
	k. HFAC-F002	Herbert
	l. HFAC-F003	Schiffler
	m. HFAC-N003	Chaikin
	n. HFAC-N004	"
	o. MIL-PRIME Update (if applicable)	Schiffler
	p. Task Analysis Update (if applicable)	Geddie
	q. ASSP Update (if applicable)	Metzler
4.	Unfinished Business	
	a. MIL-STD-490 Coverage of GAO Target Areas	Heckart
	b. HFAC Program Plan, R4	Chaikin
	c. User-Computer Interface	Peterson
	d. Life Support & Biomedical Factors Coverage	Krueger
	e. PMTC Review of 1472C, para 5.9	Mahar
	f. Fifth Percentile Female in the Workforce	Herbert
	a. TAG Proposals to the JTCG/HFE/HMI	Geddie
	b. Other	

Enclosure 1

HFSSC CORRESPONDENCE SUMMARY
(18 OCTOBER 1984 THROUGH 22 APRIL 1985)

DATE	TO	FROM	SUBJECT
18 OCT		AIA	PROPOSED MIL-STD-XXX, HFE FOR ICBM SYSTEMS
23 OCT		NARM	DISCONTINUED PARTICIPATION IN TAG
25 OCT		TS/I COMMITTEE	HFSSC/TS/I SCHEDULE CONFLICTS
5 DEC	MEMBERS AND ILRS		TRANSMITTAL OF DRAFT MINUTES
21 MAR	MEMBERS AND ILRS		POTENTIAL JLC SPONSORSHIP OF HFE ACTIONS
22 MAR	MEMBERS AND ILRS		ANNOUNCEMENT OF 12TH HFSSC MEETING
27 MAR		DOD HFE TAG COORD	ADDITION TO HFSSC MINUTES DISTRIBUTION ASSIGNMENT OF HFSSC TO SUBGROUP BLOCK A
18 APR	MEMBERS AND ILRS		CORRECTION OF LOCATION OF 12TH HFSSC MEETING
26 APR	TAG COORDINATOR		TAG PROPOSALS TO THE JTCG-HFE/HMI
26 APR	TAG CHAIRMAN		MINUTES OF 13TH TAG MEETING
1 MAY	HFAC LEAD SERV ACT		HFAC-F002, PROPOSED MIL-STD-XXX, HFE FOR ICBM SYS

HFSSC AS OF 1 MAY 85

MEMBERS

CHAIRMAN	MR. GERALD CHAIKIN (HEL-MICOM)
ARMY (HE&LS)	MR. CLARENCE A. FRY (HEL)
ARMY (P&T)	MR. JOHN L. MILES, JR. (ARI)
NAVY MEMBER (HE&LS)	DR. HEBER G. MOORE (NAVMAT)
NAVY MEMBER (P&T)	CDR LARRY M. DEAN (NPRDC)
AIR FORCE (HE&LS)	MR. STEVE A. HECKART (AFAMRL)
AIR FORCE (P&T)	MR. ROBERT N. DEEM (AFHRL)
EX-OFFICIO	MR. STEVE MERRIMAN (NADC)
	MR. TOM METZLER (AVSCOM)
	MR. LARRY PETERSON (HEL)
	LTC GERALD KRUEGER (WRAIR)
	MR. WILLIAM C. HERBERT (BMO)

INDUSTRY LIAISON REPRESENTATIVES

AIA:	MR. MAURICE A. LARUE, JR.
EIA:	MR. WOLF J. HEBENSTREIT
HFS:	DR. JULIEN M. CHRISTENSEN
AIIE:	DR. MARK M. BRAUER

STATUS OF PROJECTS

HFAC#		COMPLETED MILESTONE	DATE	STATUS
0009	PERS/TNG TASK DOCS & DIDS EPS	INITIATED	JUL 83	COORD BY JUN 85
0016	MIL-STD-1294A	COORDINATION	MAR 84	COMPL BY SEP 85
0019	NUMERIC KEYPAD STANDARDIZATION EPS	INITIATED	APR 83	COORD BY 30 JUN 85
0020	ALPHANUMERIC KEYBOARD ARRANGEMENTS EPS	INITIATED	OCT 84	COORD BY 30 SEP 85
0024	HE GUIDELINES FOR MIS (DOD-HDBK-761)	COORD	NOV 84	COMPL BY JUN 85
0025	MIL-STD-783D (TO HFAC AREA)	COMPLETED	DEC 84	COMPLETED
0026	SAE HIR 1622 ADOPTION	COMPLETED	FEB 85	COMPLETED
0027	HE PROCEDURES GUIDE	--	--	START BY JUN 85
F002	HFE/MGT FOR ICBM SYS	COORDINATION	JUL 84	COMPL BY JUN 85
--	ADOPTION, ANSI S1.8			(INIT BY DEC 84)
--	ADOPTION, ANSI S1.10			(INIT BY DEC 85)
F003	MIL-STD-1787	COMPLETED	DEC 84	COMPLETED
N003	MIL-STD-740-1	INITIATED	APR 85	COMPL BY JUN 86
N004	MIL-STD-740-2	INITIATED	APR 85	COMPL BY JUN 86
A014	MIL-HDBK-759A, N1	INITIATED	APR 85	COORD BY JUN 85

HFSSC MEETINGS

NR	DATE	LOCATION	MEM	ILR	OTH	TOT
1	13 DEC 78	HQ, NAVMAT, WASHINGTON, DC	4	1	3	8
2	5 JAN 79	MICOM, REDSTONE ARSENAL, AL	4	2	2	8
3	5 DEC 79	NASA-AMES, SUNNYVALE, CA	4	3	4	11
4	17 NOV 80	NEW ORLEANS, LA	3	3	10	16
5	18 MAY 81	NAVAL POSTGRADUATE SCHOOL, MONTEREY, CA	3	3	6	12
6	12 JAN 82	ORLANDO, FL	5	4	10	19
7	27 JUL 82	AIR FORCE ACADEMY, CO	6	3	8	17
8	8 MAR 83	EL PASO, TX	5	5	8	18
9	4 OCT 83	FAA TECH CTR, ATLANTIC CITY, NJ	8	3	9	20
10	15 MAY 84	OXNARD, CA	8	3	12	23
11	6 NOV 84	WEST POINT, NY	7	3	4	14
12	7 MAY 85	SAN ANTONIO, TX	5	2	13	20

DRAFT

Department of Defense

HUMAN FACTORS STANDARDIZATION PROGRAM (HFAC) PLAN

REVISION 4

1 MAY 85

DRAFT

ATTACHMENT O.1

Tri-Service Workload Coordinating Committee,

Report and Attendee List

REPORT OF THE COMMITTEE FOR
TRI-SERVICE WORKLOAD COORDINATION

1. <u>Nature and Purpose of the Committee</u> The group was formed to serve as an AD HOC committee in "assessing, guiding, and improving the technical investigation among all Government agencies involved in operation/crew workload RDT&E."

2. <u>Current Activities</u>

a. Change of Chairmanship - This was the last meeting for Mr. Tom Metzler who has served as the chair for the past term. The US Navy, as the next rotational service, will provide a chair for the forthcoming term.

b. Army Research Institute (ARI) - Ted Aldrich, Anacapa Sciences, Inc., Ft. Rucker, AL (on contract to ARI) presented a briefing on the Mission/Task/Workload analysis conducted in support of the Army's Light Helicopter Experimental (LHX) program. The briefing emphasized the methodology that has been developed to identify high workload during concurrent flight control, mission, and support and support tasks. The method for rating the visual, cognitive and psycho workload components of the various tasks was described. The briefing also included a description of the one-crewmember and two-crewmember models that have been developed. Ted described how the models can be exercised with various automation options being considered for the LHX. The models produce estimates of how workload is reduced when automation is interpreted into the LHX design. The briefing also presented results from some of the iterations using the models. Strengths, limitations and research issues relating to the methodology and models were also presented. (Briefing charts are enclosed for further clarification.)

c. Ms. Heidi M. Fiedler, Naval Underwater Systems Center, presented the following activity report: Because of the nature of the submarine command and control problems which is highly constrained by its operating environment yet task critical, techniques must be developed for assessing system performance - particularly system performance which includes human operators and decision makers. This need is essential to ensure continued improvement of system effectiveness. Although the development of operator workload assessment in submarine combat systems is quite nascent, ongoing activities have provided the recognition of fundamental behavioral studies and workload methodologies for impacting system design. To ensure continued system improvements of submarine combat systems, it will be necessary to maintain dialogue with other researchers to provide adequate transition of applicable concepts, techniques and innovation to our own problem setting. (Briefing charts are enclosed for further clarification.) (Request members who have further insight into approaches that have been used on past programs which may have application to this activity, contact Ms. Fiedler to offer constructive suggestion.)

d. LCDR Michael J. Pianka, Naval Air Test Center, Aircrew System Dept. presented information on the primary interest in adapting known techniques to suit the Test and Evaluation (T&E) environment, where possible, identify emerging technology to create techniques for the HF practioner to use during T&E. Currently, there are two major thrusts aimed at measuring aircrew AMSAV-ES workload. First is the development of a small, man-mounted mini-computer that can be programed to provide a family of secondary tasks in both visual and auditory models. Secondly, an attempt is underway to determine whether or not there is sufficient non-intrusive information available in a voice print to use voice stress as a workload measure.

e. Mr. Gary Reid, USAR Aeromedical Research Laboratory presented the following activity report.

(1) The criterion Task Set (CTS) is a standard set of loading tasks that have been assembled by AFAMRL. The tasks were selected to selectively load various components of the human information processing system. The tasks were also selected to clearly be the types of tasks that are performed by operational Air Force personnel. Uses for the CTS include as a standard for comparing potential secondary tasks and as loading tasks to evaluate various stresses. Software is compatible with Commodore 64 computers for interested users.

(2) Version 2.1 of SWAT software was delivered in January 1985. All past SWAT recipients will be notified about the update. Research continues on an error theory for SWAT, alternative scale development procedures and SWAT II (4 levels of the SWAT Dimensions).

(3) The Neuropsychological Workload Test Battery (NWTB) Model II is currently undergoing field testing under a contract with General Dynamics Corp. of Ft. Worth, TX. This version contains 13 physiological measures, stimulus presentation routines and data analysis. Contract completion will be in Spring of 86.

f. Mr. Cy Crites, USAF Flight Test Center presented the following information related to the use of MIL-STD 1553 data bus as a source of HF workload information.

(1) MIL-STD 1553 provides guidance to weapon developers to implement 1553 bus or busses control(s) all the message traffic from the control data computer to and from Avionics. Imbedded in this traffic are pilot-induced commands to the Avionics. The wealth of information in the recording of the 1553 (which contains all the messages) should be tapped for events, time of event, and error. Since the 1553 program was not designed for human factors requirements, the technology of extracting the task data needs to be developed. The Air Force and Navy Flight Test Centers have formed a standing committee to investigate this area.

g. Dr. Sam Schiflett presented the following activity report on the work being accomplished at the USAF School of Medicine, Brooks AFB, TX. The crew performance laboratory is in the process of updating facilities and developing new instrumentation for crew performance and workload research in the following areas:

(1) Psychophysiological Correlates of Sustained Attention to Complex Tasks.

(2) Inflight Cockpit and Crewstation Workload in C-130, AWACS (E-3), A-10 Aircraft.

(3) Development and Evaluation of Performance Assessment Batteries for Chemical Defense Protective Drug Testing.

(4) Evaluation of Performance in Hostile Environments Hypoxia (Altitude), Acceleration (+G).

(5) Development of Team Effectiveness Measures Related to C Missions.

(6) Voice Stress Algorithms for Detection of Stress Due to Task Loading or Threat Situations.

h. Mr. Joseph I. Peters, Human Performance Technology Division, Science Applications International Corporation briefed on the Cognitive/Psychomotor Effects of Prompt Radiation on Army Helicopter Crew Performance. The purpose of this effort is to assess the effects of prompt, low-dose (50-450 Rads) radiation on the performance of Army helicopter crews. Mission analyses and segmentation plus function and task analyses have been performed for the CH-47 and AH-1 helicopters. Detailed task timeline analyses have been performed on the CH-47 simulator. Within-subjects estimates were obtained from approximately 34 FORSCOM pilot/co-pilot crews on well defined task times before and after simulator missions were flown. Symptoms and symptom complexes which occur as a result of low-dose radiation exposure were identified. After flying their missions, crews were asked to project what their task times would be if they were under the influence of each of the various radiation sickness complexes. Data analyses are on-going. Future studies will include performance assessment during AH-1 simulator runs in high workload conditions and validation of the subjective projection techniques. The overall results of this effort will be used as input to models which are intended to predict a unit's combat effectiveness.

i. The workload register which is being updated for the second edition was circulated and presented for editorial correction to the attendees. Dr. Schiflett generously volunteered to review the register at length and make needed updates.

AMSAV-ES
SUBJECT: Report of the Committee for Tri-Service Workload Coordination

j. Mr. Gary Ried briefed on the progress to publish a Standard on Workload methods. He took the action to prepare and distribute a draft of the proposed Standard in October into the SubTAG membership for review prior to the November SubTAG meeting to be held in San Diego, CA.

3. USAF SAM Tour A tour of the facilities at USAF SAM was conducted on Thursday. Those in attendance had the opportunity to have a better appreciation of the state-of-the-art work that is being accomplished in workload measurement.

4. Attendance List Attendance List is provided as enclosure 1.

As past chair, I thank the members of the SubTAG for their support and contributions to the progress that has been made.

THOMAS R. METZLER
Chair, Workload Coordinating SubTAG

WORKLOAD SUBTAG COORDINATING
COMMITTEE ATTENDANCE LIST

Bill Derrick	USAF Academy, CO	AV 259-3175
Cy Crites	6520 TESTG/ENAH Edwards AFB CA	AV 350-3334
Laurel Allender	ARI, Ft. Bliss	AV 978-4491
Jay Shively	NASA-AMES Res. Ctr Moffitt Field, CA	(415) 694-6249
William Kokinakis	Ballistic Res. Lab Aberdeen Proving GD, MD	(301) 278-6291
Sam Schiflett	USAFSAM/VN Brooks, AFB, TX 78235	(512) 536-3464
Gary Loikith	Naval Air Test Center (SY-73) Patuxent River, MD	AV 356-4673
Tom McCloy	DFBL, USAFA CO 80840-5941	AV 289-3860
LCDR M. Pianka	Naval Air Test Ctr (SY70P) Patuxent River, MD	(301) 863-4157
Richard F. Gabriel	(Sys Safety Soc) Douglas Acft Dept E-71 3855 Lakewood Blvd Long Beach, CA	(213) 593-8642
Tony Santanelli	Central-CECOM Ft Monmouth, NJ	(201) 544-4145
Larry Shadow	6545TG/TIE Hill AFB, UT 84056	AV 458-6209
Gary Reid	AFAMRL/HEG Wright-Patterson AFB, OH	AV 785-8749 255-8749
Ted Aldrich	Ft. Rucker, AL	(205) 598-6326
Heidi Fiedler	Naval Underwater Sys Ctr Code 3512, Bldg 1171-1 Newport, RI 02841	AV 948-2648
Loren Wurzman	ARI, P.O. BOX 6057 Ft. Bliss, TX	(915) 568-4491
Joseph I. Peters	SAIC/1710 Goodridge Dr.	

	McLean, VA 22101	(703) 734-5861
D. Reed Morgan	AFWAL/AAAS-2 WPAFB, OH 45433	(513) 255-4827
Larry Butterbaugh	AFWAL/FIGR WPAFB, OH 45433	(513) 255-8279
Kathy Christ	USA-HEL, AMXHE-AD APG, MD	(301) 278-5836
Joseph C. Bonee	USAARENBD, ATZK-EN-TR Ft Know, KY 40121-5470	AV 464-5969
Bob Angus	DCIEM/PD, BOX 2000 Downsview, Ontario	(416) 635-2146
Matilda Reeder	ARI, Ft Rucker, AL	(205) 255-4204 AV 588-4204
Dan Mullaney	San Diego Va Med Ctr University of CA, San Diego	(619) 453-7500 Ext 3319
Nat Davis	AFLC/MMEA, WPAFB, OH	AV 787-5571
Don McCune	WR-ALC/MMEL, Robins AFB, GA	AV 468-5404
John T. Tester	00-ALC/MMEAR, Hill AFB, UT 84041	AV 458-7562

ATTACHMENT O.2

Army Research Institute/Anacapa Sciences, Inc./LHX

Mission Analyses and Workload Prediction Models

ARMY RESEARCH INSTITUTE/ANACAPA SCIENCES, INC.

LHX MISSION ANALYSES

AND

WORKLOAD PREDICTION MODELS

ARMY RESEARCH INSTITUTE TASKING

- TO CONDUCT TIME BASED MISSION ANALYSES FOR SCOUT AND ATTACK (SCAT) LHX
- IN SUPPORT OF
    - LHX TRADE-OFF DETERMINATIONS
    - LHX TRADE-OFF ANALYSES

BRIEFING OVERVIEW

OBJECTIVES

- MISSION ANALYSES
- COMPUTERIZED WORKLOAD PREDICTION MODEL

TWO-PHASED APPROACH

- TIME BASED PILOT/CREW WORKLOAD ANALYSIS OF MISSION SEGMENTS
- DEVELOPMENT OF COMPUTER-BASED MODELS FOR PREDICTING CREW WORKLOAD

RESULTS

- ONE CREWMEMBER ITERATIONS
- TWO CREWMEMBER ITERATIONS

CONCLUSIONS

OBJECTIVES

TIME BASED PILOT/CREW WORKLOAD ANALYSIS OF MISSION SEGMENTS:

- TO PROVIDE AN ANALYTICAL DATA BASE FOR

  --EXAMINING THE SINGLE VS. THE TWO CREWMEMBER REQUIREMENT ISSUE

  --CONSIDERING IMPACT OF AUTOMATION OPTIONS

  --EXAMINING FUTURE CREWMEMBER SELECTION AND TRAINING REQUIREMENTS

COMPUTERIZED MODEL FOR LHX MISSION ANALYSES:

- ALLOWS RAPID/FREQUENT ITERATIONS OF THE MISSION ANALYSES

- PRODUCES ESTIMATES OF WORKLOAD QUICKLY FOR

  --ONE CREWMEMBER CONFIGURATION

  --TWO CREWMEMBER CONFIGURATION

  --WITH VARIOUS AUTOMATION OPTIONS

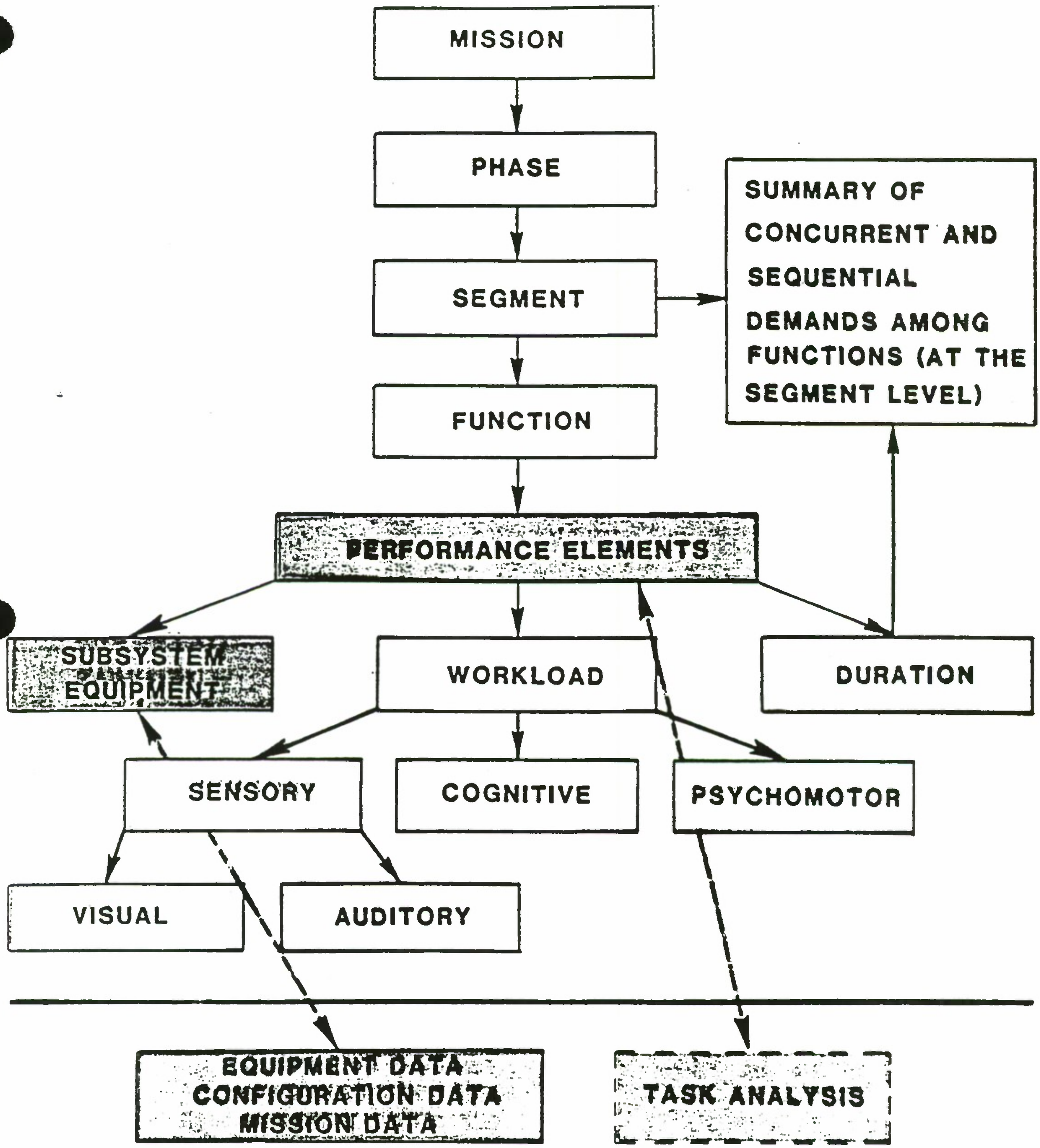
PROCEDURAL LIMITATIONS

- SYSTEMS AND PROCEDURES VIEWED GENERICALLY.
- LEVEL OF ANALYSIS AT THE FUNCTION LEVEL.
- SCOPE CONFINED TO PRIMARY MISSIONS UNDER NORMAL CONDITIONS.
- VALIDATION LIMITED TO CONTENT REVIEW BY SME'S.

ASSUMPTIONS

- BASE - CASE SUBSYSTEMS OF COMPARABLE SOPHISTICATION WITH THOSE IN OH-58D AND AH-64A
- MAJOR MISSION PARAMETERS ADHERE TO CURRENT ARMY DOCTRINE
- PROCEDURAL ROUTINES DESIGNED TO MINIMIZE OPERATOR WORKLOAD WHEN POSSIBLE
- ANALYSES REPRESENT A FIRST-STEP FOR MORE THOROUGH, SUBSYSTEM SPECIFIC ANALYSES TO FOLLOW
- FOLLOW-ON EFFORTS WILL INCLUDE EFFORTS AT VALIDATION THROUGH FLIGHT SIMULATION

ARI/ASI
LHX MISSION ANALYSES



FUNCTIONS WITHIN SEGMENTS

PHASE TARGET SERVICE

SEGMENT ACQUISITION METHOD FROM LASER CUEING

FLIGHT CONTROL	SUPPORT	MISSION
HOVER MASKED	CHECK A/C SYSTEMS	
UNMASKED SENSOR		
		RECEIVE HANDOFF (LASER CUEING)
	TRANSMIT MESSAGE (TARGET DETECTED)	

FUNCTION ANALYSIS

TOTAL TIME (APPROXIMATE) 170 seconds

FUNCTION Hover Masked No. 25

METHOD

PERFORMANCE ELEMENTS			WORKLOAD COMPONENTS			
VERB	OBJECT	SUBSYSTEM(S)	SENSORY	COGNITIVE	PSYCHOMOTOR	DURATION (SECS) DISCRETE/ CONTINUOUS
63 Control	Altitude	Flight controls F	Detect vertical movement (V-2)	Power adjustment needed? (C-1)	Control pressures (P-4)	170
64 Control	Drift	Flight controls F	Detect horizontal movement (V-2)	Cyclic adjustment needed? (C-1)	Control pressures (P-4)	170
66 Control	Heading	Flight controls F	Detect rotation (V-2)	Antitorque adjustment needed? (C-1)	Control pressures (P-4)	170
40 Check	Lateral clearance	Outside visual field V	Visual survey (V-1)	Verify clearance (C-2)	----	2.0

FUNCTION ANALYSIS

FUNCTION Receive Handoff   No. 38

TOTAL TIME (APPROXIMATE) 38.5 seconds   METHOD Laser Cueing

PERFORMANCE ELEMENTS			WORKLOAD COMPONENTS			DURATION (SECS) DISCRETE/ CONTINUOUS
VERB	OBJECT	SUBSYSTEM(S)	SENSORY	COGNITIVE	PSYCHOMOTOR	
128 Note	Message alert	Communication system (receive) CR	Auditory interp (A-3)	Decoding (C-4)	----	5
196 Transmit	Message (brief) Ack/Ready	Communication systems CT	Auditory speech feedback (A-3)	Encoding (C-4)	Switch activation Speech (P-1, P-3)	5
177 Slew	Sensor	Sensor control AC	Visual monitor (V-1)	Where to point (C-3)	Control pressures (P-4)	5
120 Note	Alert (lasing)	Communication system (receive) CR	Auditory interp (A-3)	Decoding (C-4)	----	5
76 Detect	Cueing symbol	Sensor display AT	Visual symbol (V-5)	Signal recog (C-2)	----	5
16 Align	Sight reticle	Sensor control ACS	Visual align (V-4)	Automatic (C-1)	Control pressures (P-4)	5
196 Transmit	Ack message (target detected)	Communication system CT	Auditory speech feedback (A-3)	Encoding (C-4)	Switch activation Speech (P-1, P-3)	5

WORKLOAD COMPONENTS

SCALE VALUE	DESCRIPTORS
	VISUAL
1	MONITOR, SCAN, SURVEY
2	DETECT MOVEMENT, CHANGE IN SIZE, BRIGHTNESS
3	TRACE, FOLLOW, TRACK
4	ALIGN, AIM, ORIENT ON
5	DISCRIMINATE SYMBOLS, NUMBERS, WORDS
6	DISCRIMINATE BASED ON MULTIPLE ASPECTS
7	READ, DECIPHER TEXT, DECODE
	AUDITORY
1	DETECT OCCURRENCE OF SOUND, TONE, ETC.
2	DETECT CHANGE IN AMPLITUDE, PULSE RATE, PITCH
3	COMPREHEND SEMANTIC CONTENT OF MESSAGE
4	DISCRIMINATE SOUNDS ON THE BASIS OF SIGNAL PATTERN PITCH, PULSE RATE, AMPLITUDE
	COGNITIVE
1	AUTOMATIC (SIMPLE ASSOCIATION)
2	SIGN/SIGNAL RECOGNITION
3	ALTERNATIVE SELECTION
4	ENCODING/DECODING, RECALL
5	FORMULATION OF PLANS (PROJECTING ACTION SEQUENCE, ETC.)
6	EVALUATION (CONSIDER SEVERAL ASPECTS IN REACHING JUDGMENT)
7	ESTIMATION, CALCULATION, CONVERSION
	PSYCHOMOTOR
1	DISCRETE ACTUATION (BUTTON, TOGGLE, TRIGGER)
2	DISCRETE ADJUSTIVE (VARIABLE DIAL, ETC.)
3	SPEECH USING PRESCRIBED FORMAT
4	CONTINUOUS ADJUSTIVE (FLIGHT CONTROLS, SENSOR CONTROL, ETC.)
5	MANIPULATIVE (HANDLING OBJECTS, MAPS, ETC.)
6	SYMBOLIC PRODUCTION (WRITING)
7	SERIAL DISCRETE MANIPULATION (KEYBOARD ENTRIES)

SUMMARY OF CONCURRENT AND SEQUENTIAL ATTENTION DEMANDS AMONG FUNCTIONS

PHASE TARGET SERVICE

SEGMENT ACQUISITION **METHOD** FROM LASER CUEING

CUM SECS	FLIGHT Function	V	A	C	P	SUPPORT Function	V	A	C	P	MISSION Function	V	A	C	P	TOTAL CONCURRENT V	A	C	P
10	25	2		1	4	06	5		2							7		3	4
20		2		2	4											2		2	4
30		2		2	4						38		3	4	3	2	3	6	7
40	54	2		1	4							1		3	4	3		4	8
50		2		1	4								3	4		2	3	5	4
60		2		1	4							2		2		4		3	4
70		2		1	4							4		4	4	6		5	8
80		2		1	4	49	5		4	3						7		5	7
90																			
100																			
110																			
120																			
130																			
140																			
150																			
160																			
170																			
180																			

DECISION RULES FOR BUILDING FUNCTIONS FROM PERFORMANCE ELEMENTS

CASE ONE: PERFORMANCE ELEMENTS OCCUR CONTINUOUSLY AND/OR OVERLAP DURING SEGMENTS:

EXAMPLE: FUNCTION 25: HOVER MASKED

- ALTERNATE 63, 64, AND 6 RANDOMLY ($p = .33$) FOR 170 SECONDS
- INTERRUPT WITH 40 AT TEN RANDOMLY DETERMINED TIMES DURING THE 170 SECONDS

CASE TWO: PERFORMANCE ELEMENTS OCCUR IN SEQUENCE:

EXAMPLE: FUNCTION 38: RECEIVE HANDOFF

- CALL UP PERFORMANCE ELEMENTS IN SEQUENCE

DECISION RULES FOR BUILDING SEGMENTS FROM FUNCTIONS:

SEGMENT **ACQUISITION** METHOD **FROM LASER CUEING**

FLIGHT	SUPPORT	MISSION
START SEGMENT WITH FUNCTION 25. FUNCTION 25 LASTS 170 SECONDS.	INTRODUCE FUNCTION 6 AT 3 RANDOM TIMES DURING THE FIRST 159 SECONDS OF FUNCTION 25. FUNCTION 6 LASTS 11.5 SECONDS. COMPLETE 6 BEFORE FUNCTION 38 STARTS.	START FUNCTION 38 AFTER 159 SECONDS OF FUNCTION 25 HAVE ELAPSED. (THIS ALLOWS THE FIRST TWO PERFORMANCE ELEMENTS (11 SECONDS) OF FUNCTION 38 TO OCCUR DURING THE HOVER MASKED FLIGHT MODE (FUNCTION 25). FUNCTION 38 LASTS FOR 38.5 SECONDS. THUS 27.5 SECONDS OF 38 WILL OCCUR DURING FUNCTION 54.
START FUNCTION 54 WHEN FUNCTION 25 ENDS. FUNCTION 54 LASTS 43.5 SECONDS (EXTEND 54 FROM 21.5 TO 43.5 SECONDS BY ADJUSTING TIME FOR PERFORMANCE ELEMENT 181).		
(FUNCTIONS 49 AND 54 SHOULD END AT THE SAME TIME.)	START FUNCTION 49 AS SOON AS FUNCTION 38 ENDS. FUNCTION 49 LASTS 16 SECONDS.	
SEGMENT ENDS		

TABLE 3

SUBSYSTEM CODES FOR GENERIC SUBSYSTEMS IDENTIFIED IN THE MISSION ANALYSIS

CODE	SUBSYSTEM
A	TARGET ACQUISITION SUBSYSTEM
AC	ACQUISITION SENSOR CONTROLS
ACF	ACQUISITION SENSOR CONTROLS/FOV
ACL	ACQUISITION SENSOR CONTROLS/LASER
ACS	ACQUISITION SENSOR CONTROLS/SIGHT
AD	ACQUISITION SENSOR DISPLAY
ADC	ACQUISITION SENSOR DISPLAY CONTROLS
ADS	ACQUISITION SENSOR DISPLAY/SIGHT
AK	TARGET KEYBOARD SYSTEM
AL	LASER RANGEFINDER
ALD	LASER DESIGNATOR
AR	SENSOR DISPLAY/RANGE
AS	SENSOR DISPLAY/SCENE
AT	SENSOR DISPLAY/TARGET CUE
C	COMMUNICATION SUBSYSTEM
CC	COMMUNICATION COORDINATION
CD	MESSAGE DISPLAY
CM	MESSAGE DEVICE
CR	COMMUNICATION SYSTEM/RECEIVE
CS	COMMUNICATION SYSTEM/SELECT
CT	COMMUNICATION SYSTEM/TRANSMIT
D	DISPLAY SUBSYSTEM
DE	ENGINE STATUS DISPLAYS
DEW	ENGINE CAUTION DISPLAYS
DF	FUEL SYSTEM DISPLAY
DT	THREAT DISPLAY/AURAL
DTV	THREAT DISPLAY/VISUAL
DM	MALFUNCTION DETECTION EQUIPMENT

CODE	SUBSYSTEM
F	FLIGHT CONTROL SUBSYSTEM
FAD	FLIGHT CONTROLS, SENSOR DISPLAY
FD	FLIGHT INSTRUMENTS
FP	POWER CONTROL
FV	FLIGHT CONTROLS/VISUAL
FVD	FLIGHT CONTROLS, VISUAL SCENE, DISPLAY
I	FIRE CONTROL SUBSYSTEM
ID	FIRE CONTROL DISPLAY
IP	FIRE CONTROL PANEL
L	LIFE SUPPORT SYSTEM
N	NAVIGATION SUBSYSTEM
NC	NAVIGATION CONTROLS
ND	NAVIGATION DISPLAY
NDC	NAVIGATION/COORDINATE DISPLAY
NDF	NAVIGATION DISPLAY/FLIGHT CONTROLS
NSM	NAVIGATION SENSOR SCENE AND MAP
P	PERSONAL EQUIPMENT/COCKPIT ITEMS
PC	CHECKLIST
S	AIRCRAFT SURVIVABILITY EQUIPMENT
SC	CHAFF DISPENSER
V	VISUAL FIELD UNAIDED
VD	VISUAL FIELD/SENSOR DISPLAY
VM	VISUAL FIELD/MAP
VND	VISUAL FIELD/NAVIGATION, DISPLAY

COMPUTER PROGRAMS

- SEGMENTS CALL UP FLIGHT CONTROL, SUPPORT AND MISSION FUNCTIONS
- FUNCTIONS CALL UP PERFORMANCE ELEMENTS
- PERFORMANCE ELEMENTS CALL UP WORKLOAD ESTIMATES
- ONE HALF SECOND TIME LINE
- PRINTS LINE OUT WHEN
  - VALUES CHANGE
  - OVERLOAD OCCURS

WORKLOAD TABULATIONS

- OVERLOAD CONDITIONS
- OVERLOADS
- OVERLOAD DENSITY
- SUBSYSTEM OVERLOADS

SEGMENT NUMBER: 25
SEGMENT TITLE : ENGAGEMENT, AIR TO AIR, FROM MASKED POSITION

CUM. SECS.	FLIGHT PERFORMANCE ELEMENTS	V A C P	SUPPORT PERFORMANCE ELEMENTS	V A C P	MISSION PERFORMANCE ELEMENTS	V A C P	TOTAL V A C P	SUBSYSTEM F	S	M
FN. NUMBER:25 FN. TITLE :HOVER MASKED			6 CHECK A/C SYSTEMS (PWR CHG)							
FN. NUMBER:25 FN. TITLE :HOVER MASKED										
122.5	CONTROL HEADING	2 0 1 4					2 0 1 4			
FN. NUMBER:25 FN. TITLE :HOVER MASKED			6 CHECK A/C SYSTEMS (PWR CHG)							
133.0	CONTROL HEADING	2 0 1 4	ADJUST POWER	0 0 1 0			2 0 2 4			
134.0	CONTROL DRIFT	2 0 1 4	CHECK SYSTEMS	5 0 2 0			7 0 3 4			
135.5	CHECK CLEARANCE	1 0 2 0	CHECK SYSTEMS	5 0 2 0			6 0 4 0			
138.0	CONTROL HEADING	2 0 1 4	CHECK SYSTEMS	5 0 2 0			7 0 3 4			
FN. NUMBER:25 FN. TITLE :HOVER MASKED										
144.5	CONTROL ALTITUDE	2 0 1 4					2 0 1 4			
154.0	CHECK CLEARANCE	1 0 2 0					1 0 2 0			
156.5	CONTROL DRIFT	2 0 1 4					2 0 1 4			
FN. NUMBER:54 FN. TITLE :UNMASK SENSOR										
170.5	INCREASE ALTITUDE	2 0 2 4					2 0 2 4			
FN. NUMBER:54 FN. TITLE :UNMASK SENSOR					48 TRACK TARGET					
176.0	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
176.5	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
177.0	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
177.5	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
178.0	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
178.5	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
179.0	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
179.5	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
180.0	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
180.5	INCREASE ALTITUDE	2 0 2 4			ALIGN RETICLE	4 0 1 4	6 0 3 8	FVD		ACS
181.0	CHECK LOS	1 0 2 4			ALIGN RETICLE	4 0 1 4	5 0 3 8	ADC		ACS
181.5	CHECK LOS	1 0 2 4			TRACK TARGET	4 0 3 4	5 0 5 8	ADC		AC
182.0	CHECK LOS	1 0 2 4			TRACK TARGET	4 0 3 4	5 0 5 8	ADC		AC
182.5	CHECK LOS	1 0 2 4			TRACK TARGET	4 0 3 4	5 0 5 8	ADC		AC
183.0	CHECK LOS	1 0 2 4			TRACK TARGET	4 0 3 4	5 0 5 8	ADC		AC
183.5	CHECK LOS	1 0 2 4			TRACK TARGET	4 0 3 4	5 0 5 8	ADC		AC
184.0	CHECK LOS	1 0 2 4			TRACK TARGET	4 0 3 4	5 0 5 8	ADC		AC

OVERLOAD DENSITY COMPUTATION

$$\frac{\text{NUMBER OF TIMELINES WITH OVERLOADS}}{\text{TOTAL NUMBER OF TIMELINES IN SEGMENT}}$$

OR

$$\text{OVERLOAD DENSITY} = \frac{\text{NUMBER OF TIMELINES WITH OVERLOADS}}{\text{SEGMENT TIME x 2}}$$

AUTOMATION OPTIONS EXERCISED BY THE MODELS

FLIGHT CONTROL:

- HOVER HOLD FOR CONTROLLING HEADING, ALTITUDE, DRIFT
- AUTOMATIC INCREASE ALTITUDE MODE DURING HOVER, VOICE COMMANDED
- AUTOMATIC DECREASE ALTITUDE MODE DURING HOVER, VOICE COMMANDED
- AUTOMATIC ALIGNMENT OF AIRCRAFT HEADING ON TARGET DURING HOVER, VOICE COMMANDED
- AUTOMATIC MANEUVER NOE

TARGET ACQUISITION:

- AUTOMATIC SEARCH
- AUTOMATIC RANGE CALCULATION
- AUTOMATIC TARGET DETECTION
- AUTOMATIC SIGHT ALIGNMENT
- AUTOMATIC TARGET TRACKING
- AUTOMATIC TARGET RECOGNITION
- AUTOMATIC TARGET PRIORITIZATION
- AUTOMATIC TARGET RECAPTURE

NAVIGATION:

- AUTOMATIC DISPLAY OF AIRCRAFT POSITION RELATIVE TO SELECTED WAYPOINTS
- AUTOMATIC UPDATING OF POSITION

AUTOMATION OPTIONS EXERCISED BY THE MODELS - CONT'D

FIRE CONTROL:

- AUTOMATIC WEAPON SELECTION, VOICE COMMANDED
- AUTOMATIC VERIFICATION AIRCRAFT IS IN FIRING CONSTRAINTS
- AUTOMATIC WEAPON RELEASE
- AUTOMATIC DE-ARMING OF WEAPON FUNCTION AFTER WEAPON RELEASE

COMMUNICATION:

- VOICE PLAYBACK FOR MESSAGE DISPLAY
- AUTOMATIC AUTHENTICATION OF MESSAGE
- CHANNEL SELECTION BY VOICE COMMAND
- VOICE RECORDER FOR MESSAGE ENTRY DURING LOW WORKLOAD INTERVALS
- AUTOMATIC TRANSMISSION FROM RECORDER UPON VOICE COMMAND

SURVIVABILITY:

- AUTOMATIC DIAGNOSIS AND VERIFICATION OF THREAT SIGNALS
- AUTOMATIC STORAGE OF THREAT SOURCE LOCATIONS
- AUTOMATIC ACTIVATION OF ELECTRONIC COUNTERMEASURES

OTHER:

- VOICE DISPLAYS FOR SYSTEM CHECKS
- VOICE PRESENTATION OF CHECKLIST

FUNCTION ANALYSIS

TOTAL TIME 170 seconds (APPROXIMATE)

FUNCTION Hover Masked — No. 25

AUTOMATION OPTIONS Hover Hold

PERFORMANCE ELEMENTS			WORKLOAD COMPONENTS			DURATION (SECS) DISCRETE/ CONTINUOUS	COMMENTS
VERB	OBJECT	SUBSYSTEM(S)	SENSORY	COGNITIVE	PSYCHOMOTOR		
63 CONTROL	ALTITUDE	FLIGHT CONTROLS (F)	MONITOR AIRCRAFT MOVEMENT (V-1)	----	----	170	ALTERNATE PEs 63, 64, AND 66 RANDOMLY (.33 PROBABILITY) A HALF-SECOND INTERVALS FOI 170 SECONDS. INTERJECT PE 4 RANDOMLY FOR 2.5 SECONDS AT THE RATE OF 10 TIMES DURING THE 170-SECOND PERIOD.
64 CONTROL	DRIFT	FLIGHT CONTROLS (F)	MONITOR HORIZONTAL MOVEMENT (V-1)	----	----	170	
66 CONTROL	HEADING	FLIGHT CONTROLS (F)	MONITOR ROTATION (V-1)	----	----	170	
40 CHECK	LATERAL CLEARANCE	OUTSIDE VISUAL FIELD (V)	VISUAL SURVEY (V-1)	VERIFY CLEARANCE (C-2)	----	2.0	

SIXTEEN COMBINATIONS OF AUTOMATION OPTIONS EXERCISED BY THE ONE- AND TWO-CREWMEMBER MODELS

1. HOVER HOLD + AUTOMATIC INCREASE AND DECREASE IN ALTITUDE DURING HOVER, VOICE COMMANDED + AUTOMATIC MANEUVER NOE
2. HOVER HOLD + AUTOMATIC INCREASE AND DECREASE IN ALTITUDE DURING HOVER, VOICE COMMANDED + AUTOMATIC ALIGNMENT OF HEADING ON TARGET
3. HOVER HOLD + AUTOMATIC INCREASE AND DECREASE IN ALTITUDE DURING HOVER, VOICE COMMANDED
4. HOVER HOLD + AUTOMATIC INCREASE IN ALTITUDE DURING HOVER, VOICE COMMANDED
5. HOVER HOLD + AUTOMATIC ALIGNMENT OF AIRCRAFT HEADING ON TARGET DURING HOVER HOLD
6. HOVER HOLD + AUTOMATIC DECREASE ALTITUDE DURING HOVER, VOICE COMMANDED
7. AUTOMATIC DIAGNOSIS AND VERIFICATION OF THREAT SIGNALS + AUTOMATIC ACTIVATION OF ELECTRONIC COUNTERMEASURES
8. HOVER HOLD + AUTOMATIC SIGHT ALIGNMENT
9. EIGHT AUTOMATION OPTIONS FROM THE TARGET ACQUISITION SUBSYSTEM
10. THREE FLIGHT CONTROL AUTOMATION OPTIONS COMBINED WITH EIGHT TARGET ACQUISITION SYSTEM AUTOMATION OPTIONS
11. FOUR FLIGHT CONTROL AUTOMATION OPTIONS COMBINED WITH EIGHT TARGET ACQUISITION SYSTEM AUTOMATION OPTIONS
12. THIRTEEN AUTOMATION OPTIONS FROM THE NAVIGATION, COMMUNICATION, FIRE CONTROL, AND TARGET ACQUISITION SUBSYSTEMS
13. MISSION EQUIPMENT PACKAGE (MEP) AUTOMATION OPTIONS
14. REQUIRED OPERATIONAL CAPABILITY (ROC) AUTOMATION OPTIONS
15. TWENTY-EIGHT AUTOMATION OPTIONS
16. TWENTY-NINE AUTOMATION OPTIONS

PRACTICAL APPLICATIONS

SYSTEMATIC PREDICTION OF HUMAN OPERATOR WORKLOAD

EARLY DECISIONS IN HUMAN ENGINEERING DESIGN

- MAN-MACHINE FUNCTIONAL ALLOCATION
- ESTIMATES OF SENSORY WORKLOAD PROVIDE INFORMATION ABOUT DISPLAY REQUIREMENTS
- ESTIMATES OF PSYCHOMOTOR WORKLOAD PROVIDE INFORMATION ABOUT CONTROL REQUIREMENTS
- ESTIMATES OF COGNITIVE WORKLOAD PROVIDE INFORMATION ABOUT HUMAN FACTOR REQUIREMENTS THROUGHOUT THE CREW STATION

ITERATIVE IMPROVEMENT IN ANALYSES AS SYSTEM DEFINITION PROCEEDS

EVOLVE TO TASK ANALYSES AS HARDWARE DECISIONS ARE MADE

STRENGTHS:

A SYSTEMATIC METHOD OF PREDICTING WORKLOAD IN ADVANCE OF SYSTEM DESIGN

METHODOLOGY IS ITERATIVE--ESTIMATES CAN BE REFINED IN STEP WITH SYSTEM DESIGN

PROVIDES EARLY HUMAN ENGINEERING INPUTS

- FUNCTIONAL ALLOCATIONS--HUMAN VS. MACHINES
- DISPLAY REQUIREMENTS
- CONTROL REQUIREMENTS

CONSERVATIVE WORKLOAD ESTIMATES

- TIME ESTIMATES CONSERVATIVELY LONG
- SUPPORT FUNCTIONS SCHEDULED ON TIME-LINE TO AVOID HIGH WORKLOAD
- FLIGHT CONTROL FUNCTIONS EXTENDED

  --NO TIME STRESS OVERLOADS
- ESTABLISHMENT OF OVERLOAD THRESHOLD VALUE OF "8"
- SUMMING WORKLOAD COMPONENTS TO COMPUTE TOTAL WORKLOAD
- MISSION DEGRADATION NOT ACCOUNTED FOR

LIMITATIONS AND RESEARCH ISSUES

- SUBJECTIVE WORKLOAD ESTIMATES
- SCALES NOT SUBJECTED TO RELIABILITY AND VALIDITY STUDIES
- SUMMING MODALITY VALUES TO DERIVE TOTAL WORKLOAD ESTIMATES
- TREATING WORKLOAD COMPONENTS AS SEPARATE INDEPENDENT ENTITIES
- ARBITRARY DESIGNATION OF "8" AS OVERLOAD THRESHOLD
- SUBJECTIVE TIME ESTIMATES
- TIME STRESS OVERLOAD NEGLECTED IN THESE ANALYSES

SUMMARY OF RESULTS

FLIGHT CONTROL AUTOMATION OPTIONS REDUCE WORKLOAD IN ONE-CREWMEMBER CONFIGURATION--ARE INEFFECTIVE IN TWO-CREWMEMBER CONFIGURATION.

TARGET ACQUISITION, NAVIGATION, COMMUNICATION, AND FIRE CONTROL AUTOMATION OPTIONS REQUIRED IN EITHER CONFIGURATION.

FLIGHT CONTROL AUTOMATION OPTIONS PRIMARILY REDUCE PSYCHOMOTOR OVERLOADS: TARGET ACQUISITION, NAVIGATION, COMMUNICATION, AND FIRE CONTROL AUTOMATION OPTIONS PRIMARILY REDUCE VISUAL AND COGNITIVE OVERLOADS.

EXCESSIVE WORKLOAD REMAINS IN SIX SEGMENTS WHEN THE ONE-CREWMEMBER MODEL IS EXERCISED WITH A COMBINATION OF 29 AUTOMATION OPTIONS.

TARGET ACQUISITION AUTOMATION OPTIONS REDUCE EXCESSIVE WORKLOAD IN THE TWO-CREWMEMBER MODEL MORE THAN AUTOMATION OPTIONS FROM THE OTHER SUBSYSTEM CATEGORIES,

FINDINGS SUPPORTING TWO-CREWMEMBER LHX

- ALL OVERLOAD CONDITIONS ELIMINATED BY 9 AUTOMATION OPTIONS
- PILOT OVERLOADED ONLY DURING THREE OF THE MISSION SEGMENTS, EVEN WITHOUT AUTOMATION
- FOURTEEN MISSION SEGMENTS CAN BE PERFORMED WITHOUT OVERLOAD WITH NO AUTOMATION
- OVERLOAD CONDITIONS ARE REDUCED MORE BY ADDING A SECOND CREWMEMBER THAN BY:

  --ANY SINGLE AUTOMATION OPTION,

  --SIX COMBINATIONS OF FLIGHT CONTROL SYSTEM AUTOMATION OPTIONS,

  --A COMBINATION OF EIGHT TARGET ACQUISITION OPTIONS, AND/OR

  --A COMBINATION OF 13 NAVIGATION, COMMUNICATION, FIRE CONTROL, AND TARGET ACQUISITION AUTOMATION OPTIONS.

CONCLUSIONS

- HIGH DEGREE OF AUTOMATION REQUIRED FOR ONE-CREWMEMBER CONFIGURATION
  --OVERLOAD CONDITIONS REMAIN IN SOME MISSION SEGMENTS

- MODERATE AUTOMATION REQUIRED IN A TWO-CREWMEMBER LHX
  --ALL OVERLOAD CONDITIONS ELIMINATED

- DRAMATIC REDUCTION IN OVERLOAD CONDITIONS ACHIEVABLE BY ADDING A SECOND CREWMEMBER

- RESULTS SUPPORT TWO-CREWMEMBER LHX CONFIGURATION

\- - - - - - - - - - - - -

VALIDATION OF THE ARI/ANACAPA METHODOLOGY AND MODELS IS REQUIRED

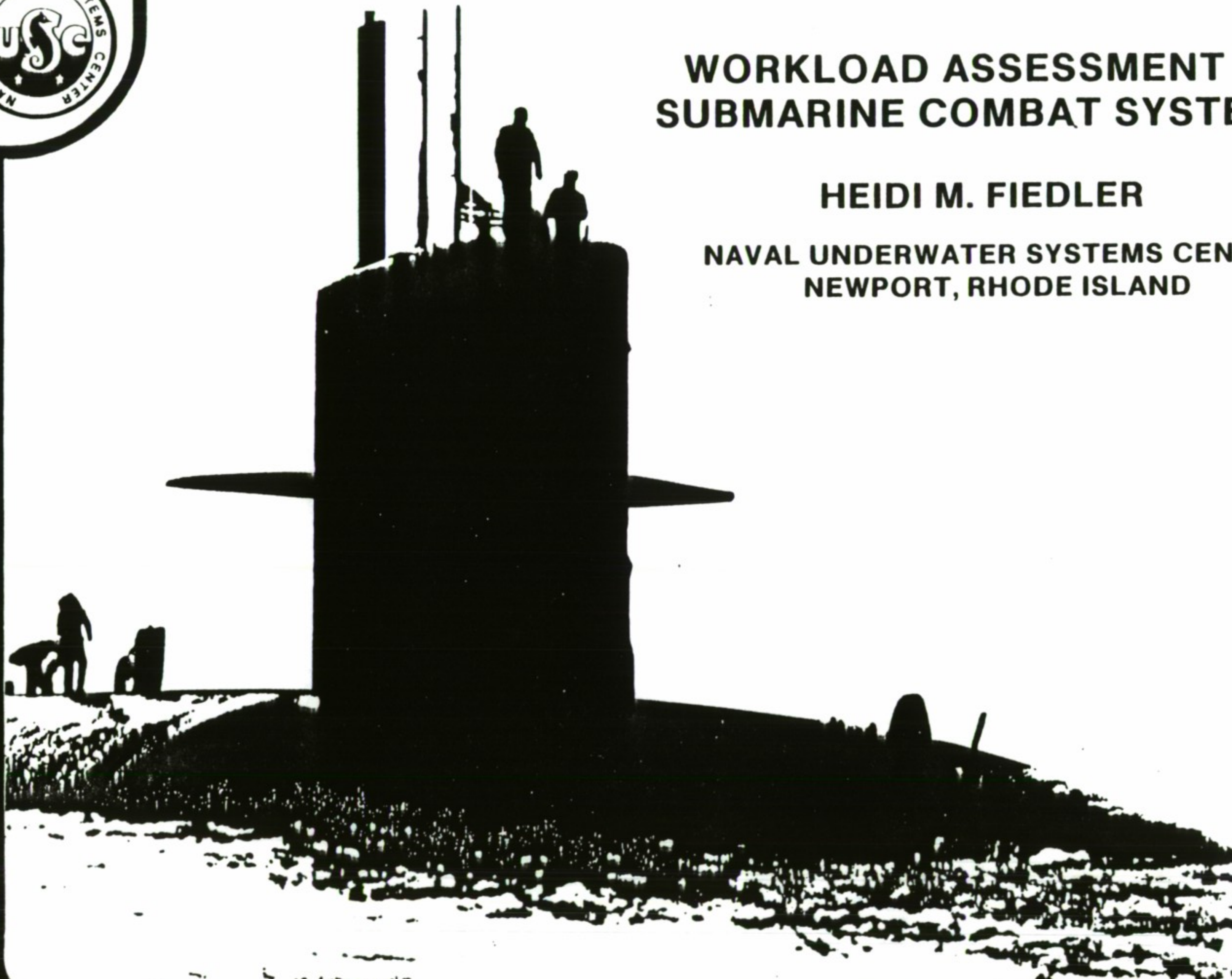
ATTACHMENT O.3

Workload Assessment in Submarine Combat Systems

WORKLOAD ASSESSMENT IN SUBMARINE COMBAT SYSTEMS

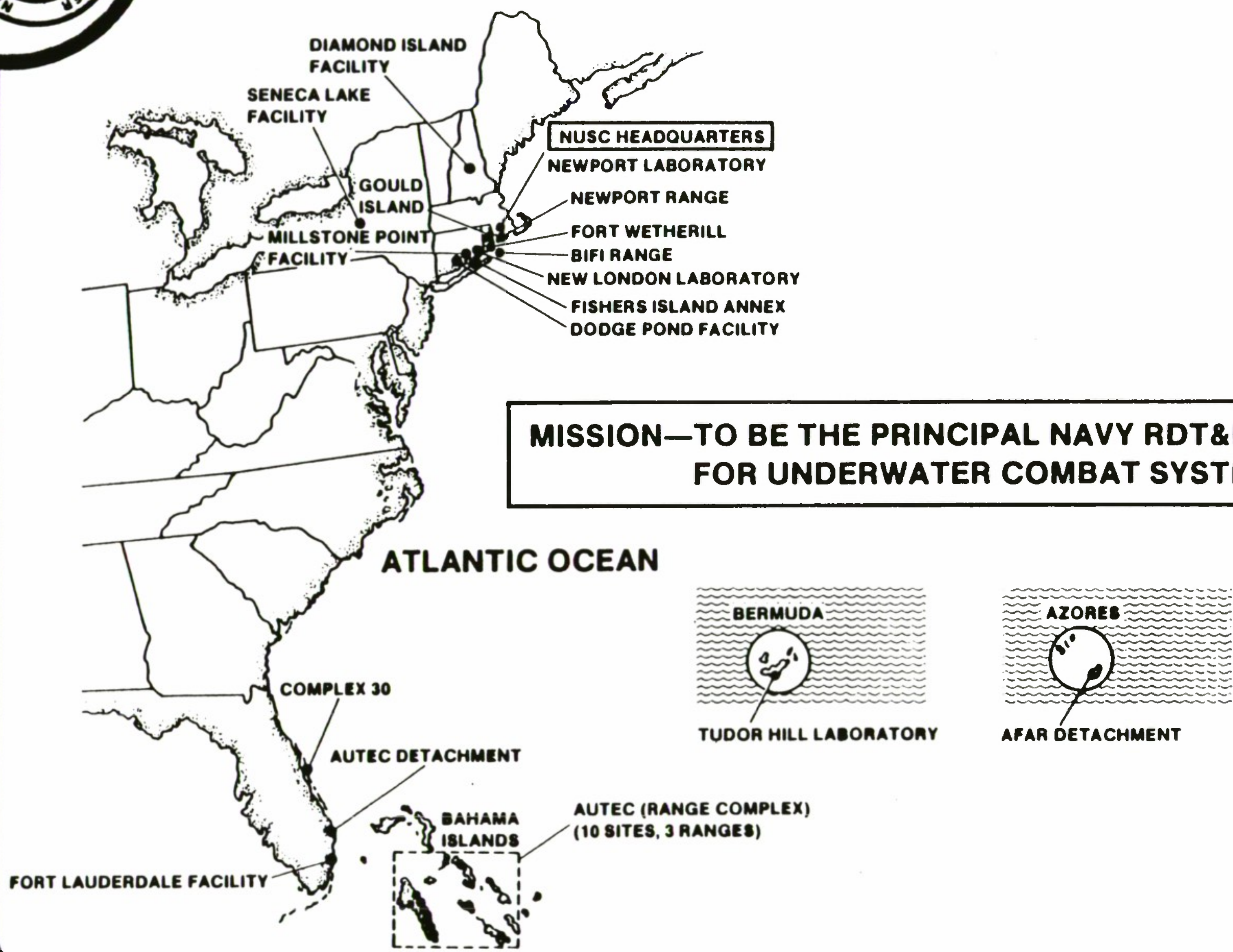
HEIDI M. FIEDLER

NAVAL UNDERWATER SYSTEMS CENTER
NEWPORT, RHODE ISLAND



INFO. TECH.-1
LC 4/16/85

NAVAL UNDERWATER SYSTEMS CENTER



MISSION—TO BE THE PRINCIPAL NAVY RDT&E CENTER FOR UNDERWATER COMBAT SYSTEMS.

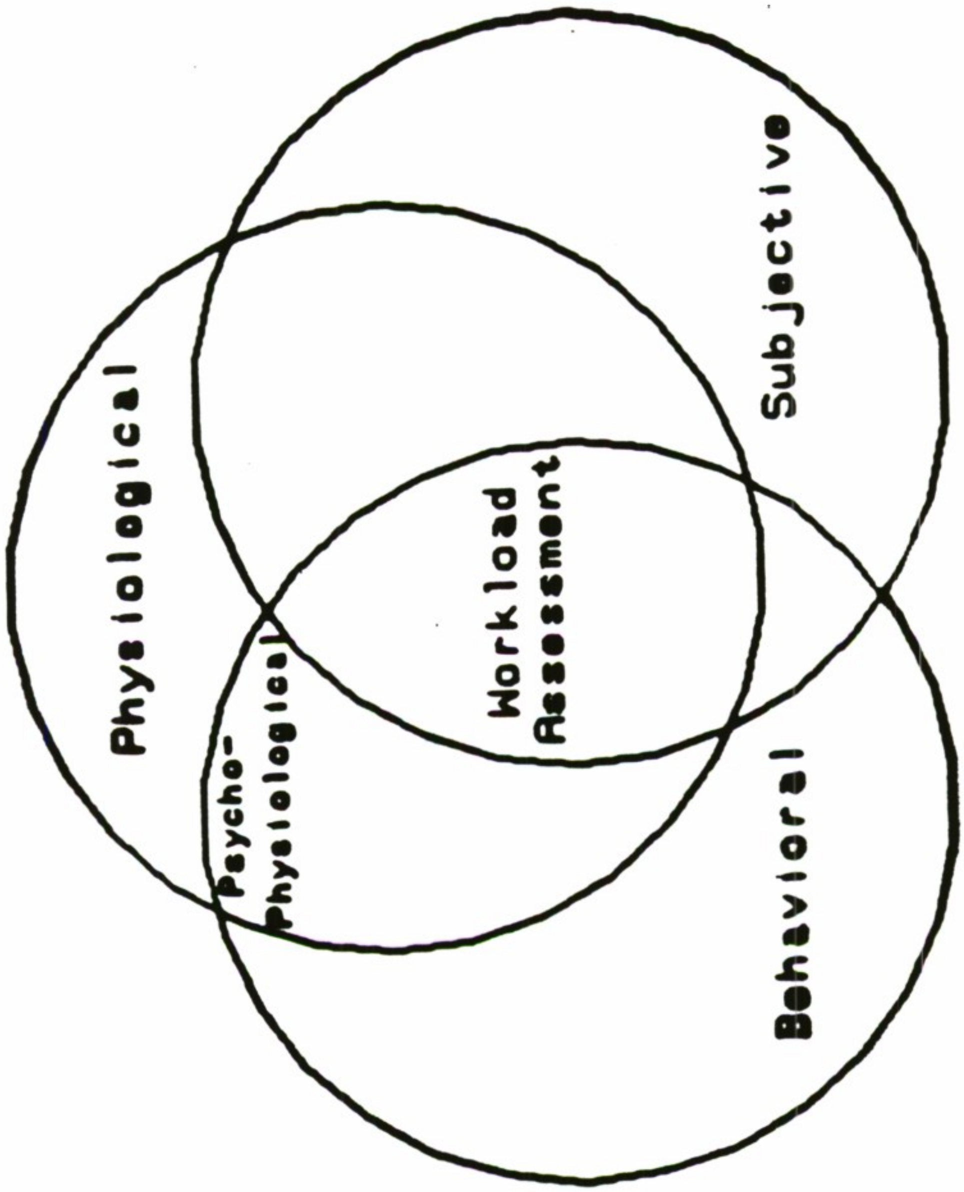
COM. SYS. 2
LC 4/18/85

WORKLOAD ASSESSMENT IN THE SUBMARINE ENVIRONMENT

WHAT IS THE SUBMARINE-SPECIFIC PROBLEM?

- COMBAT SYSTEM ISSUES
  - — INCREASING MISSION REQUIREMENTS
  - — INCREASING SYSTEM COMPLEXITY
  - — DATA UNCERTAINTY/POROSITY/SENESCENCE
  - — MULTIPLE/VARYING TASKS
  - — MULTIPLE OPERATORS
- CURRENT SYSTEMS/FUTURE SYSTEMS

INFO. TECH.-19
LC 5/6/85


Subjective
Physiological
Workload Assessment
Psycho-Physiological
Behavioral

LONG-TERM OBJECTIVE

DESIGN A METHODOLOGY TO EVALUATE MENTAL WORKLOAD OF OPERATORS, AS A GROUP, IN THE COMBAT CONTROL SYSTEM (CCS) ENVIRONMENT.

1/8/85

HISTORY OF WORKLOAD ASSESSMENT IS IN AVIATION

...NEED TO GENERALIZE THE THEORIES TO THE SUBMARINE SETTING AND DEVELOP METHODOLOGIES SPECIFIC TO COMBAT CONTROL TASKS

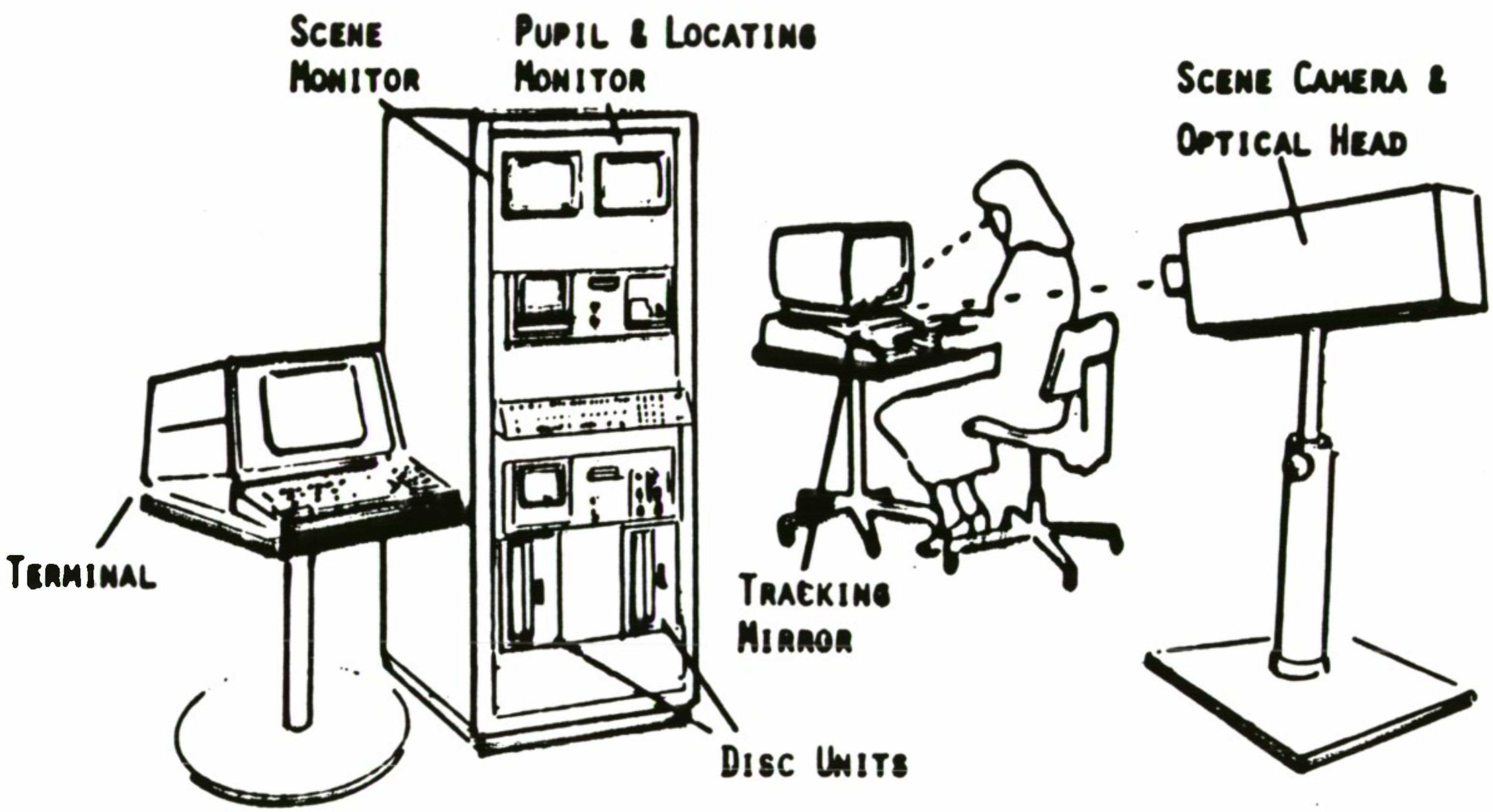
3512 12/14/84

EYE MOVEMENT AND PUPILLOMETRIC MEASURES

- SCANNING PATTERNS
- BLINK RATE
- NUMBER OF FIXATIONS
- DWELL TIME
- PUPIL DIAMETER

1/8/85

VDT CONFIGURATION



WORKLOAD ASSESSMENT METHODOLOGIES

BEHAVIORAL METHODOLOGIES
- TIME TO COMPLETE TASK
- ACCURACY
- RT
- DUAL TASK STUDIES
- SEARCH PATTERNS

PHYSIOLOGICAL MEASURES
- PUPIL SIZE
- EYE BLINK RATE

SUBJECTIVE MEASURES
- SWAT
- MODIFIED COOPER-HARPER (MCH)
- PSYCHOPHYSICAL SCALE (GOPHER & BRAUN)

INFO. TECH.-20
LC 5/6/85

SUMMARY

- Identify and Characterize the Submarine–Specific Workload Setting
- Transition Technology from Industry, Academia, and the Tri–Services
- Develop a Methodology to Evaluate Individual and Group Workload in the CCS Environment

ATTACHMENT P

User-Computer Interaction -- Report and View Graphs

CHAIRMAN'S REPORT

UCI SUB-TAG MEETING

The sub-TAG on user-computer interface research met on 7 May. There were a number of key issues discussed which are outlined below.

1. Sub-TAG areas of emphasis -

To respond to the needs of new members and to help clarify the information held by existing members, the main areas of emphasis and concern of the sub-TAG were discussed. It was noted that these fell into three main categories: the traditional information exchange forum typical of most sub-TAGS; the support and coordination work with the DoD STARS effort; and the identification and, were possible, joint research approach to HFE problems of mutual concern among the three services - such as the need for a tri-service standard for the user-computer interface area. Presentations and discussions followed relating to these three areas.

2. STARS program status report.

The chairman reported on the current state of the STARS program. From the point of view of the human factors field, it was noted that more than 600k had been allocated for HFE support in the areas of the Joint Services Software Engineering Environmental (JSSEE) and Human Resources groups. This will enable the start of work to integrate human factors into the overall STARS effort, particularly in the area of interface design and software module support. The level of funding is expected to increase in FY 86 and sub-TAG members were asked to help identify to the STARS program areas of research which could be funded.

3. STARS/Industry Meeting Report.

Dr. Mark Brauer, who represented the UCI sub-TAG at a combined industry/STARS conference where the program was outlined to industry, reported on the results of the meeting. Dr. Brauer's notes and viewgraphs are included as a separate appendix to this report, thus the subject will not be dealt with in detail here. In summary, the program was well received by industry, who will be expected to share in the research effort and funding for the multi-year program. Emphasis throughout the presentation was on the reusability of the software programs and modules - an emphasis which is likely to exist in strength throughout the STARS program life-cycle.

4. Sub-TAG internal business.

Two items of concern to the sub-TAG as a whole were dealt with at the meeting. A two-year tenure was approved for the chairperson in order to foster greater continuity for the group's efforts and to help bring increased stability to the management of the group at a stage when several important things are going on. The present chair-person will remain for two more meetings in order to facilitate this changeover.

The second item of concern was the need for a backup chairperson, who would function to work with the existing chair and to chair meetings and maintain progress in the absence of the elected chair. This is also an area in which the group was responding to the need for increased continuity. Dr. John O'Hare of the Office of Naval Research was elected to the position of chairperson-elect and will serve for the next two meetings in this capacity.

5. Database prototype demo.

Representatives from Battelle Laboratories demonstrated a prototype layout for the proposed HFE database and information exchange network under design by the US Army Human Engineering Laboratory. The presentation slides are included as a separate appendix to this report.

Comments were solicited from the members present regarding layout of the screens and displays. Final system design will incorporate inputs from the intended user community in order to ensure maximum usability of the database.

6. Dr. Rodger Koppa from Texas A&M University presented an update briefing on work in progress in the area of keyboard design. Work on the 4x4 military keypad and function key recommendations to MIL-STD-1280 was discussed, and an overview of preliminary data on membrane keypad responsivity was given. Final data reports on this work will be presented at the next TAG meeting.

7. Dr. John O'Hare presented to the group an outline and recommendations for a proposal review committee for future STARS research work. A draft of a suggested outline to bidders (Appendix) was suggested as a good starting point, and comments are solicited from group members as to how best to construct this committee. We will be submitting (from within DoD) and reviewing (form DoD, industry and academia) a considerable number of research proposals in the UCI area over the next few years, so we need to set up as smooth a process as possible to accommodate this.

8. Formation of UCI Standards Working Group.

The present chair of the UCI sub-TAG will also be chairing a working group in the area of UCI standards. The goal of this group is to recommend to the Human Factors Standardization Steering Committee (HFSSC) an appropriate plan of attack and approximate schedule for a stand-alone UCI standards document which will expand on the work currently embodied in the relevent section of database MIL-STD-1472. At the same time, ongoing database and research work at HEL will be integrated onto this effort and a coordinated game-plan developed.

9. Combined/Sequential UCI/Controls and Displays meeting.

Due to the overlap and related interest areas between members of these two groups, it was suggested that a coordinated meeting be held which would permit members of the two groups to discuss separate and joint areas of concern. Sequential meeting days would be used to ensure that people could attend both group meetings where desired, and every effort will be made to present items of interest to all. This is a good idea, and a trial meeting will be held sometime during the period before the next mother-TAG meeting. Details will follow as soon as available.

USER-COMPUTER INTERFACE

GROUP MEETING AGENDA

1330	CONVENE - OPENING REMARKS	
	STARS PROGRAM - PROGRESS	LARRY PETERSON
	STARS/INDUSTRY MEETING REPORT	MARK BRAUER
	CONSORTIUM REPORT	MARK BRAUER
	CO-CHAIRPERSON PROPOSAL	
	2-YEAR CHAIRPERSON TENURE	
1430	BATTELLE DBASE PROTOTYPE	LOUIS TIJERINA
1445-1500	BREAK/SERVICE CAUCUS	
1500	BATTELLE WORK IN PROGRESS	
	UCI STANDARDS WORKING GROUP	
	UCI/STARS PROPOSAL REVIEW COMMITTEE	JOHN O'HARE
1545	GENERAL DISCUSSION AND FUTURE MEETING PLANS	
1625	SESSION ENDS	

Update: May 1985

AREA: User, Interface Medium/Equipment

ORGANIZATION: Computer Science and Systems Branch
Naval Research Laboratory, Washington, D.C. 20375

PRINCIPAL INVESTIGATOR & PHONE NUMBER : Robert J. K. Jacob
(202) 767-3365

OBJECTIVES: Investigate use of formal specification technique for describing interactive user interfaces and develop suitable specification technique, with particular concern for problems of multi-level secure systems.

APPROACH: Have studied and tested specification techiques for use interfaces.

PROGRESS: Developed approach based on state transition diagrams, with separate specifications for each of three levels of interface design. Built interpreter to make specifications executable for producing rapid prototypes. Applied new technique to two non-trivial systems -- prototype secure computer-based military message system and submarine intelligence analysis aid. Currently investigating extensions to specification notation for concurrent dialogues and use of specification in formal verification of security properties.

EQUIPMENT: VAX, SUN

INTERFACE CONTROLLERS:

AREA: Interface Medium/Equipment

ORGANIZATION: Human Factors Engineering
Douglas Aircraft Company, Long Beach, CA

PRINCIPAL INVESTIGATOR & PHONE NUMBER: Michael A. Biferno, Ph.D.
(213) 593-6645

OBJECTIVE: Determine suitability of advanced digital controls for transport aircraft and develop methods for evaluating crew workload, fatigue and performance with airborne computer systems.

APPROACH: Conduct laboratory and simulation experiments.

PROGRESS: Various completed experiments and simulations and hardware demonstrations.

STATUS: Active research program in progress.

EQUIPMENT: Programmable legend keys, touch panels, miscellaneous keyboards, 11/23 lab computer, 11/44 with 160MB Winchester, miscellaneous part-task simulators, full mission simulation, motion base simulator, miscellaneous color CRTs.

INTERFACE CONTROLLERS: Serial and parallel.

Update: April 1985

AREA: Interface Medium/Equipment

ORGANIZATION: Office of Naval Research Contract Research Program: ONR contract N00014-83-C-0495 Work Unit NR DSA-009

PRINCIPAL INVESTIGATOR & PHONE NUMBER: Alan Morse, PhD
(413) 253-3482
Intelligent Software Systems, Inc.
Amherst Fields Research Park
160 Old Farm Road
Amherst, MA 01002

OBJECTIVES: The design, assembly and evaluation of a graphics workstation for dynamic data display. User acceptability to be measured with novice users and subsequent design modifications are validated to define a concept of a personalized display system.

APPROACH: A work station will be designed for graphic presentations of complex, time-varying, animated data. A series of experiments will be conducted to support the design of three independent software modules for the display systems that include: (1) a user interface to give the user a model of the system and the ability to switch among its available formats, (2) a facility to define new data formats, and (3) a facility to construct new display contexts in which the data may be embedded.

PROGRESS: A preliminary design of the work-station has been assembied partially and tested successfully.

STATUS: The research program began on 1 July 1983 and will continue until 31 July 1985.

EQUIPMENT: SUN Microsystem, Model 100 with Color graphics option.

INTERFACE CONTROLLERS:

UCI PROGRAM DESCRIPTION

AREA: Submarine Combat System User-Computer Interface

ORGANIZATION: Combat Control Systems Department, Code 3512
Naval Underwater Systems Center
Newport, Rhode Island 02841

PRINCIPAL INVESTIGATOR: Heidi Fiedler
(401) 841-2648
AV 948-2648
Electronic Mail: NUSC-NPT/NUSC-ADA

OBJECTIVES: The development and application of human engineering principles to submarine combat systems.

APPROACH: Primary research under NUSC IR/IED project "Application of Psychophysiological Measurements to Submarine Combat Control" is focused on the characterization of single and group operator performance in an attack center setting and is closely aligned with other related NUSC activities in mental models, cognitive style, expert systems development, display prototyping, and SSN mockup development.

PROGRESS: A research test-bed has been developed to support investigations and development of the submarine combat control (CC) user-computer interface. Earlier efforts included the development of full-scale SSN attack center mockups and a remote UCI test-bed capability. Current efforts are concerned with the identification of suitable performance measures, behavioral-physiological correlates of workload, and experimental designs to assess user performance in the SSN CC setting.

STATUS: This technology base phase of submarine combat control human engineering is in its nascency.

EQUIPMENT: HP-9000, VAX 11/780, LMI LISP Machine, and PDP 11/70 commercial computers and AN/UYK 43(XN-1)(V) and AN/UYK-7(V) military computers. SSN full-scale mockup. Gulf & Western Eye-tracking System. Magnavox-Photonics (1 meter) flat panel display.

INTERFACE CONTROLLERS: Megatek 3355, Lexidata 8000, LEX-90, Ramtek 9400, Jupiter-7, HP-97060, Adage 4100, and WCC MK 81 Mod 1/3.

UCI PROGRAM DESCRIPTION

AREA: Format of software code

ORGANIZATION: Office of Naval Research (Code 442), Arlington, VA 22217
Contract research program
Work unit # NR 196-191

PRINCIPAL INVESTIGATOR: PHONE & ELECTRONIC MAIL NUMBER
Dr. Deborah A. Boehm-Davis
George Mason University Ph: (703) 323-2203
Department of Psychology
4400 University Drive
Fairfax, VA 22030

OBJECTIVES: To verify that relational or associational mental models are predictive of programmer performance during the modification of software code and during changes to the content and relationsnips within data bases.

APPROACH: Software codes for three types of problems (resource allocation, sensor integration, and editing of address lists) are modified by experienced programmers according to a set of new specifications. The software code is presented in three different formats that vary along a representational dimension that depicts the decomposition of the problem: data-structure techniques; object-oriented techniques; and functional techniques. The effectiveness of each format type is experimentally evaluated in terms of the amount of time required to complete the modification, the number of errors made, and the number of modules that make up the software code which require change. The mental models utilized by the programmers in the modification task are inferred, cognitive-interface principles are defined, and the dependencies between problem type and the quality of the software program are examined.

PROGRESS: This research program is a continuation of work unit #NR 196-183 initiated by the same PI at General Electric Company; that first contract has been terminated. The start date of the new program is scheduled for 1 Feb 85.

STATUS:
Procurement negotiations are nearing completion.

EQUIPMENT: CDC Cyber computer system and associated peripherals.

INTERFACE CONTROLLERS: N.A.

ATTACHMENT Q.1

Voice-Interactive Systems -- View Graphs

VOICE-INTERACTIVE SYSTEMS SUBTAG

NAME: JOE PETE SEVERO (202) 274-9420 /AV 284-9420

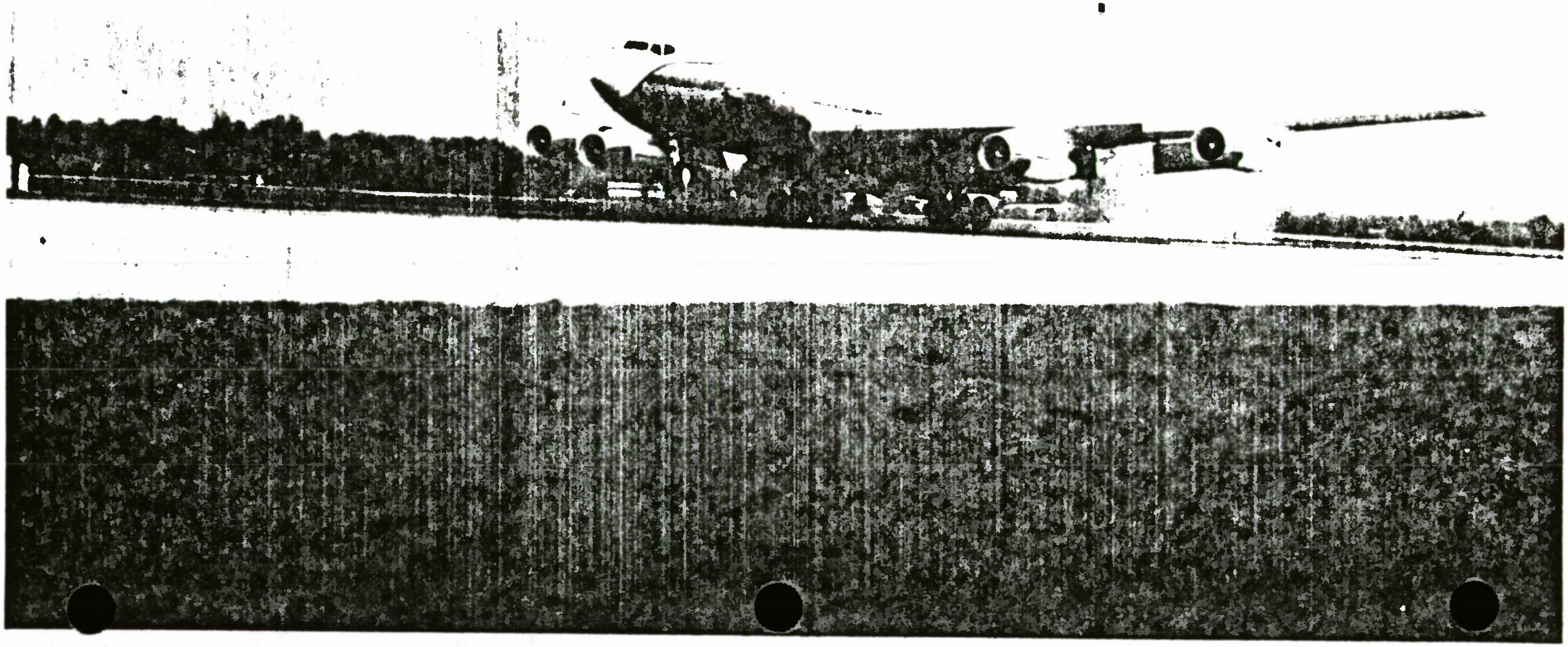
TITLE: SPECIAL ADVISOR FOR INFORMATION TECHNOLOGY

ORGANIZATION: ARMY RESEARCH INSTITUTE (ARI)

OVERVIEW:

ARI MAINTAINS AS PART OF IT'S REALTIME RESEARCH FACILITY, BOTH VOICE SYNTHESIS AND RECOGNITION SYSTEMS. VOICE EQUIPMENT SUCH AS SOUNDPROOF BOOTHS, AUDIO RECORDING AND VOICE DEVICES FROM TEXAS INSTRUMENTS, INTERSTATE, VOTAN AND ITT ARE IN USE. RESEARCH INCLUDES: VINT^2, MAN-MACHINE/ADAPTIVE SYSTEMS WITH EFFORTS AIMED AT ASSISTING IN THE RECOMMENDING OF VOICE CAPABILITIES FOR TANKS/ARMORED VEHICLES AND OTHER ARMY GROUND-BASED SYSTEMS.

"SPECKLED TROUT"
RESEARCH AND DEVELOPMENT PROGRAM



LARGE AIRCRAFT FLIGHT MANAGEMENT
VOICE TECHNOLOGY DEMONSTRATION

OBJECTIVE:

- PROMOTE THE AWARENESS OF VOICE RECOGNITION TECHNOLOGIES IN AIRCRAFT APPLICATIONS

APPROACH:

- FIG DIRECTED LOW COST, QUICK RESPONSE EFFORT
  - IN-HOUSE PERSONNEL AND FACILITIES
- MISSION RELEVANT
  - COMM/NAV

LARGE AIRCRAFT FLIGHT MANAGEMENT
VOICE TECHNOLOGY DEMONSTRATION

- REPRODUCED AIRCRAFT NOISE ENVIRONMENT IN AMRL'S VOICE COMMUNICATIONS RESEARCH EVALUATION SYSTEM (VOCRES) FACILITY

- TESTED VOICE BOARDS WITH AIC-18/M-87 INTERFACE
  - NOISE RANGE, 85 db - 104 db
  - P-T-T SWITCH INTERFACE DETERMINED
  - VOCABULARY ESTABLISHED
  - OPTIMUM AUDIO GAIN OF MODIFIED BOARDS SELECTED

- VALIDATED VRT-300 IN AIRCRAFT NOISE ENVIRONMENT

LARGE AIRCRAFT FLIGHT MANAGEMENT
VOICE TECHNOLOGY DEMONSTRATION

ACCOMPLISHMENTS TO DATE

ACCOMPLISHMENTS:

- SUCCESSFULLY DEMONSTRATED TO VIP PERSONNEL
  - JAN 84 THRU JAN 85
  - GEN. GABRIEL, GEN. SKANTZ, GEN. MARSH, GEN. McMULLEN, GEN. YATES, GEN. JOHNSON (AFLC) & FOREIGN DIGNITARIES
  - ARTICLES IN NUMEROUS PUBLICATIONS

    SKYWRIGHTER
    CINCINNATI, CEDAR RAPIDS (AP RELEASE)
    INDUSTRY NEWS
    DEFENSE ELECTRONICS
    AFSC NEWS REVIEW
- FINAL REPORT IN PREPARATION

LARGE AIRCRAFT FLIGHT MANAGEMENT VOICE TECHNOLOGY DEMONSTRATION

LESSONS LEARNED

- ISOLATED WORD RECOGNITION IS NOT ADEQUATE FOR DATA ENTRY
  - TIME
  - MENTAL EFFORT
  - PHYSIOLOGICAL STRESS
- HIGHLY DEPENDENT ON SPEAKER STYLE
- ADD-ON VOICE CAPABILITY INTRODUCES A VARIETY OF PROBLEMS AFFECTING SYSTEM ACCEPTANCE
  - ADD-ON DISPLAY (FEEDBACK)
  - MECHANICAL CONTROL HEADS (CONFLICT)
  - NON INTERACTIVE
- RELIABLE TEMPLATE STORAGE AND RETRIEVAL SYSTEM
- PERSONNEL STRONGLY DIVIDED ON UTILITY

ESTABLISHED THE NEED FOR A FOCUSED SYSTEMS APPLICATION DEMONSTRATION

LARGE AIRCRAFT FLIGHT MANAGEMENT

VOICE TECHNOLOGY DEMONSTRATION PROGRAM

OBJECTIVE:

- DEMONSTRATE AND EVALUATE INTERACTIVE VOICE CONTROL TECHNOLOGY IN A REAL WORLD ENVIRONMENT
- DEVELOP AND MAINTAIN AN ACTIVE GROUND FACILITY TO FACILITATE RESEARCH IN ADVANCED VOICE INTERACTIVE SYSTEMS

APPROACH:

- FLIGHT RESEARCH
  - PHASE I; MINIMUM RADIO CONFIGURATION
    (VHF, TACAN, VOR/ILS, IFF)
    AUG 1984 - SEPT 1985
  - PHASE II; FULL-UP VOICE ACTIVATED RADIO MANAGEMENT SYSTEM
    OCT 1985 - DEC 1986
- GROUND RESEARCH (VOICE SYSTEMS LAB, AIRCRAFT MOCK-UP)
  - PHASE I; MINIMUM CAPABILITY; FEB 85 - SEPT 85
  - PHASE II; FULL CAPABILITY; OCT 85 - SEPT 86

LARGE AIRCRAFT FLIGHT MANAGEMENT
VOICE TECHNOLOGY DEMONSTRATION PROGRAM

FLIGHT RESEARCH - PHASE I

- PHASE I INITIATES THE IMPLEMENTATION OF AN INTEGRATED, VOICE ACTIVATED, MULTI-USER RADIO MANAGEMENT SYSTEM BASED ON A DUAL 1553B BUS ARCHITECTURE

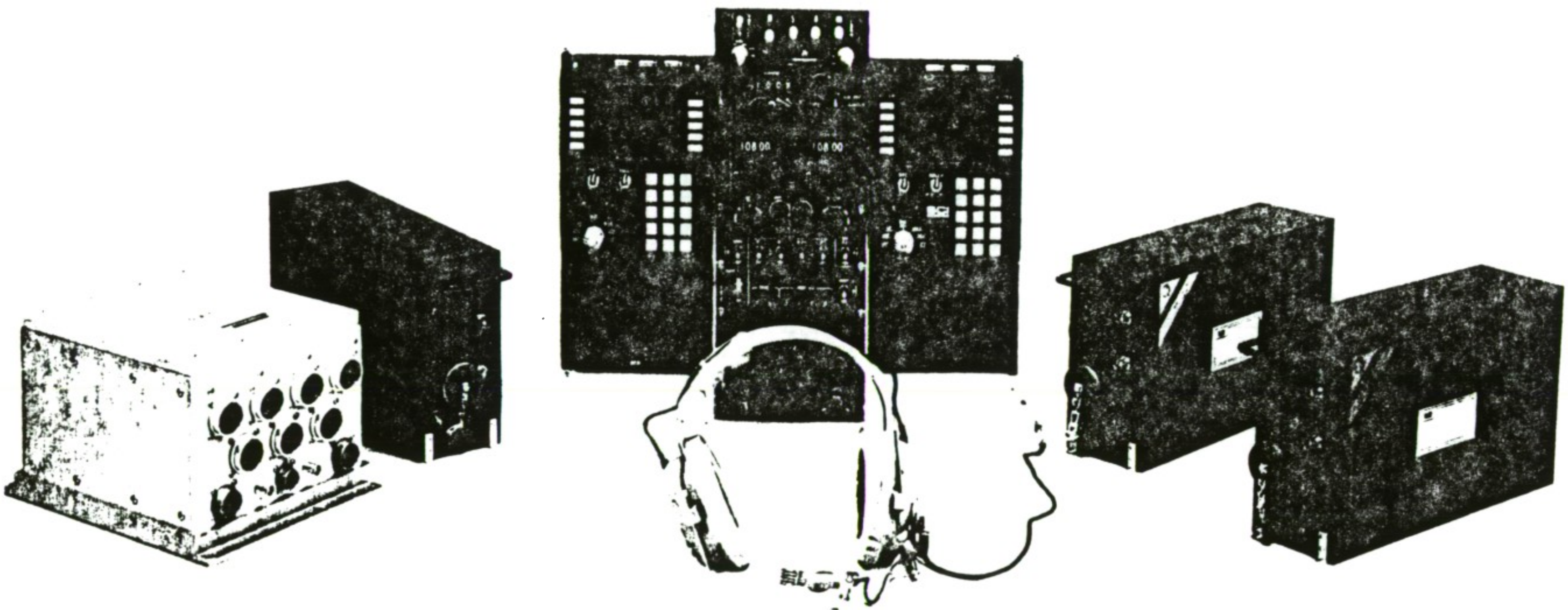
  - VOICE INCORPORATED AS AN INTEGRAL DESIGN CONCEPT

  - SYSTEMS DEVELOPMENT/INTEGRATION
    JOINT AFWAL/SPECKLED TROUT/SCI EFFORT

  - INSTALLATION IN JUNE/JULY 1985

  - FLIGHT TEST BEGINNING IN JULY 1985

LARGE AIRCRAFT FLIGHT MANAGEMENT
VOICE TECHNOLOGY DEMONSTRATION PROGRAM



LARGE AIRCRAFT FLIGHT MANAGEMENT
VOICE TECHNOLOGY DEMONSTRATION

EXPERIMENTS

- GROUND RESEARCH
  - DEVELOP REALISTIC/RELEVANT MISSION SCENARIO
  - SUBJECTIVE WORKLOAD ASSESSMENT TECHNIQUE (SWAT) (TIME, MENTAL EFFORT, PHYSIOLOGICAL STRESS)

  RESEARCH IS NECESSARY TO ESTABLISH PROCEDURES FOR ANALYZING HUMAN-MACHINE COMMUNICATION TASKS AND TO ESTABLISH THE BENEFITS OF SPEECH I/O

- IN-FLIGHT RESEARCH
  - TOTAL TIME TO PERFORM TASK, VOICE vs MANUAL
  - SUBJECTIVE EVALUATIONS
  - RECOGNITION PERFORMANCE

  GAIN PRACTICAL KNOWLEDGE ABOUT APPLICATIONS. ESTABLISH THE LIMITATIONS OF EXISTING TECHNOLOGY

GROUND TESTING

OBJECTIVES

- DEVELOP CONNECTED SPEECH DATA BASE TO OPTIMIZE IN-FLIGHT PERFORMANCE
- INVESTIGATE PERFORMANCE TRADEOFFS
  - SYNTAXED VS. OPEN VOCABULARY
  - QUIET VS NOISE ENROLLMENT
  - ISOLATED VS EMBEDDED TRAINING
- DETERMINE PREDICTION CAPABILITY OF IN-FLIGHT PERFORMANCE
- IDENTIFY SHORTFALLS OF CURRENT TECHNOLOGY
  - FLEXIBLE NUMERIC DATA ENTRY
    - ONE-TWO-THREE-POINT-SIX-FIVE
    - ONE-TWENTY-THREE-SIXTY-FIVE

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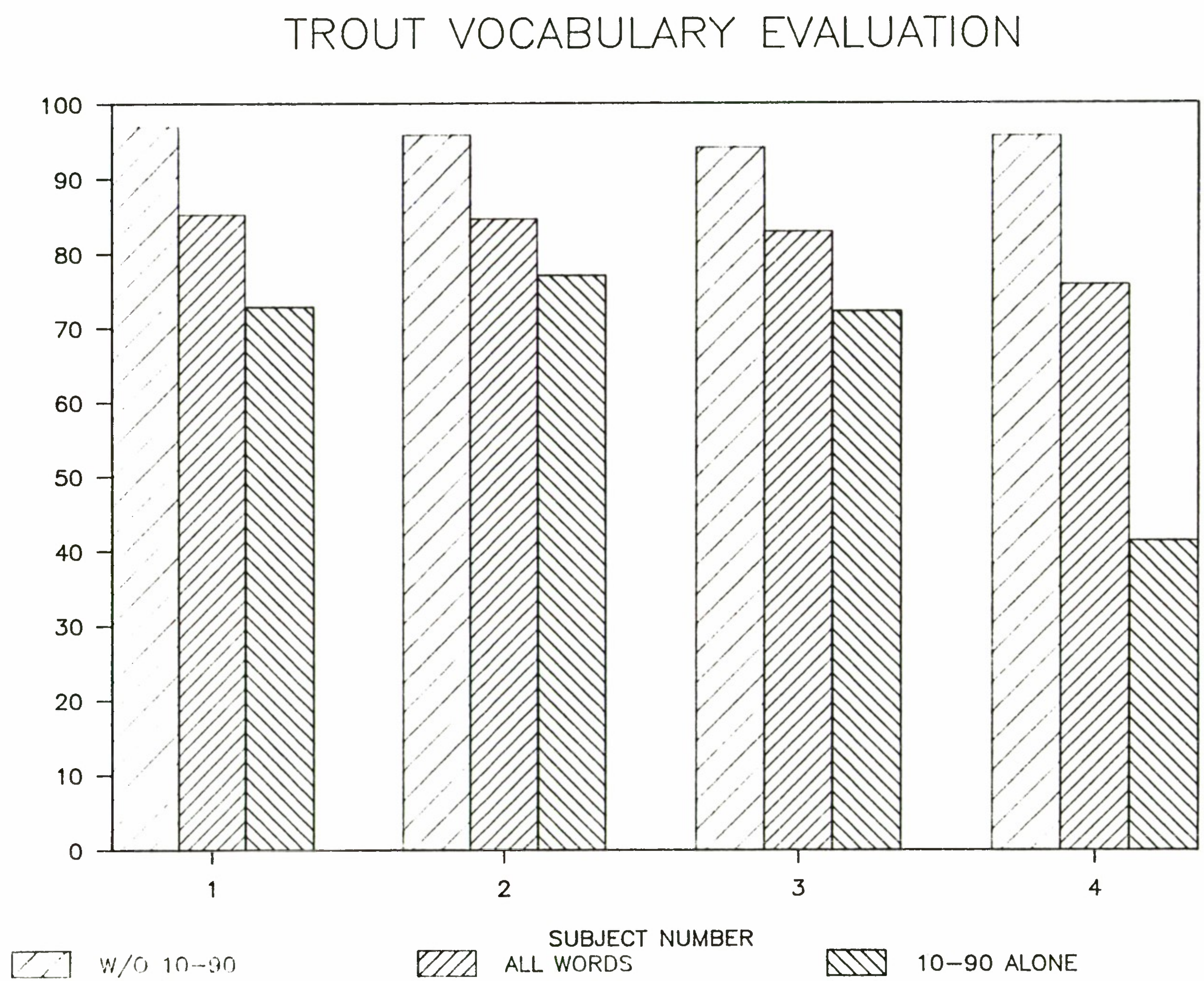
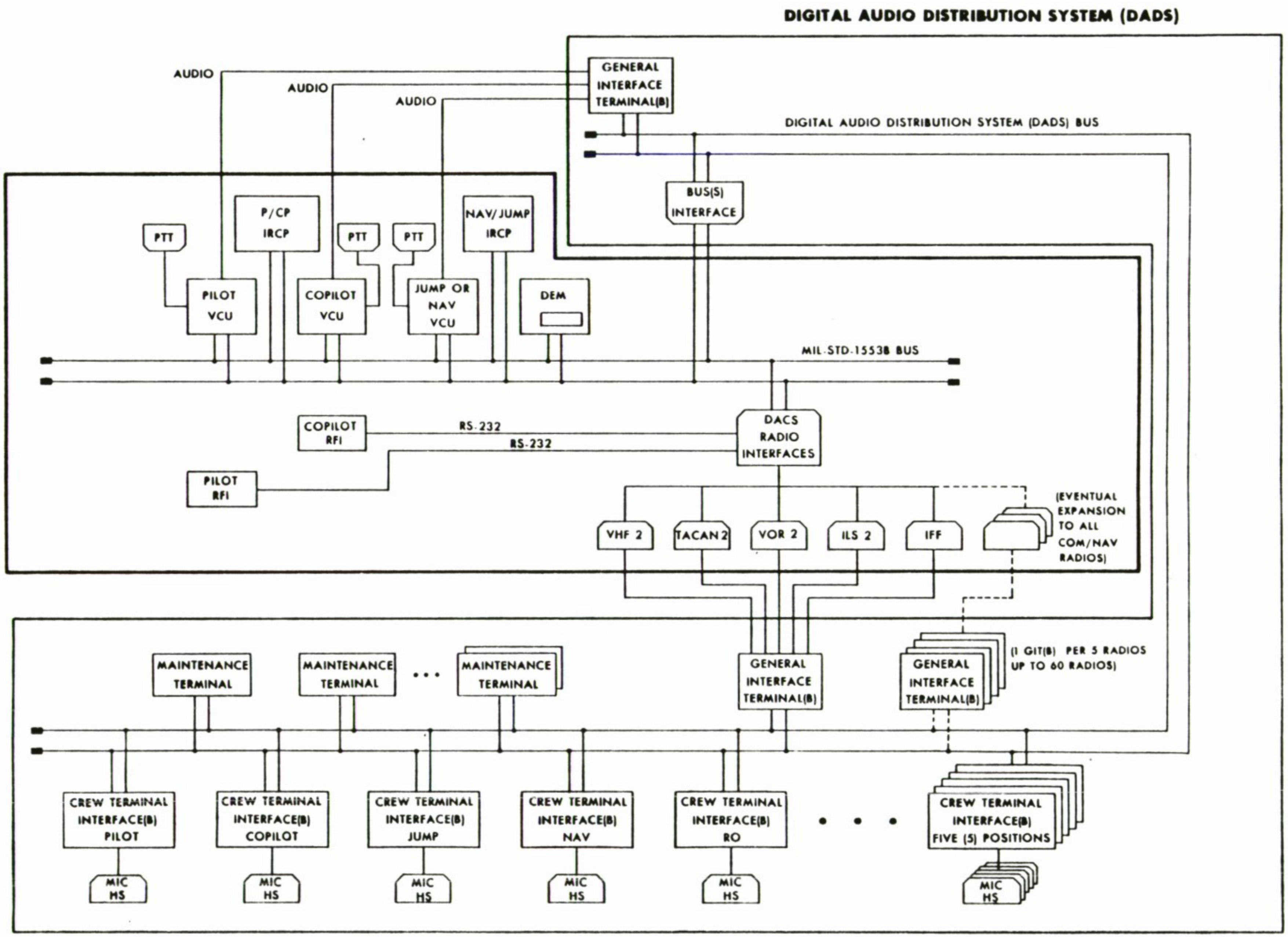

TROUT VOCABULARY EVALUATION
%ACCURACY
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
SUBJECT NUMBER
W/O 10-90
ALL WORDS
10-90 ALONE

IN-FLIGHT DATA COLLECTION

- DETAILED RECOGNITION DATA
  - WINNER WORD / TEMPLATE NUMBER
  - WINNER SCORE
  - RUNNER UP WORD / TEMPLATE NUMBER
  - RUNNER UP SCORE
  - DELTA SCORE-DERIVED
  - PEAK AMPLITUDE
- VOICE DATA RECORDINGS
  - TRANSCRIPTION NECESSARY FOR ERROR DETERMINATION
  - THROUGHPUT RATES - DERIVED

G→

VOICE ACTIVATED, INTEGRATED COMMUNICATION/NAVIGATION MANAGEMENT SYSTEM



LOTUS 123
AS A
RECOGNIZER EVALUATION
TOOL

D. WILLIAMSON

OUTLINE

- ANALYSES POSSIBLE WITH 123
  - THRESHOLD EFFECT
  - DELTA EFFECT
  - WORD EFFECT
- TESTING THE MODEL
  - VPC-2000 EVALUATION
    - THRESHOLD EFFECT
    - NOISE EFFECT
    - DELTA EFFECT

G

THRESHOLD EFFECT

RT	%ACC	%SUB	%REJ	INS
30				
35				
40				
45				
50				
55				
60				
65				
70				

DELTA EFFECT

RT = ____

DT	%ACC	%SUB	%REJ	INS
0				
2				
4				
6				
8				
10				

G→

WORD EFFECT

WORD #	%ACC	AVG DIST	STD DEV	COUNT
1				
2				
3				
4				
5				
•				
•				
•				
N				

G→

MCS 4 5 437

VPC-2000 EVALUATION

GROUND RULES

- 3 TRAINING PASSES / WORD
  - CHOSEN FROM REPETITIVE UTTERANCES
- NO TEMPLATE CHECKING
- REJECTION THRESHOLD FIXED AT 70

G→

RECOGNITION DATA FORMAT

- SEQUENTIAL TEXT FILE
- DATA RECORD FORMAT

SPOKEN	W1	D1	W2	D2
12	12	35	5	53

- INSERTION ERROR TAGGING

  SPOKEN = WORD # O

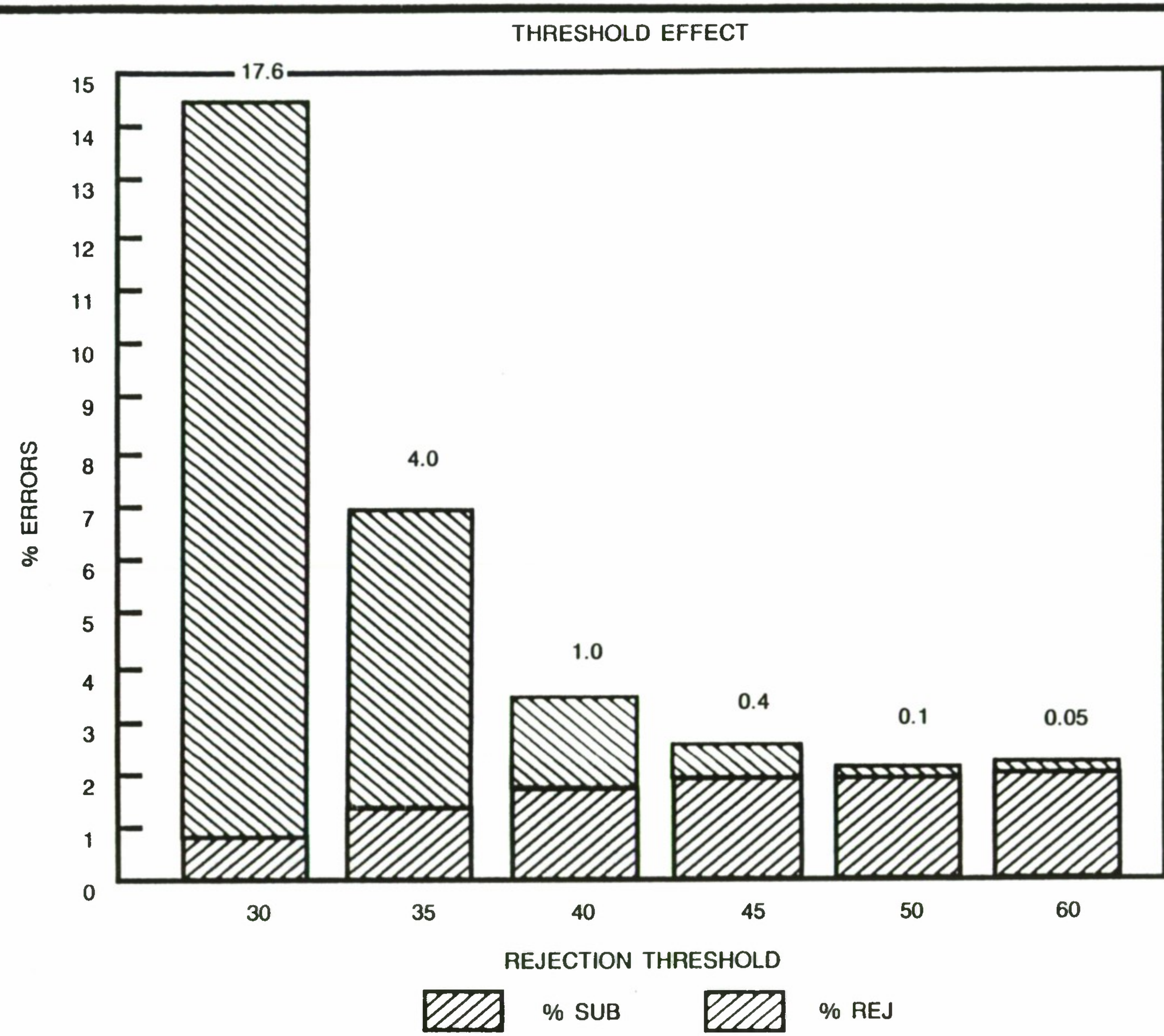
VPC-2000 EVALUATION

THRESHOLD EFFECT

RT	%ACC	%SUB	%REJ	INS
30	85.0	0.8	13.7	9
35	92.7	1.4	5.6	14
40	96.5	1.7	1.7	22
45	97.5	1.9	0.7	37
50	97.9	1.9	0.2	49
55	97.9	1.9	0.2	65
60	97.9	2.0	0.1	100
65	97.9	2.0	0.1	151
70	97.9	2.0	0.1	187

G→

VPC—2000 EVALUATION



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VPC-2000 EVALUATION

DELTA EFFECT

RT = 30

DT	%ACC	%SUB	%REJ	INS
0	85.0	0.8	14.2	9
2	84.8	0.6	14.7	8
4	84.2	0.3	15.5	3
6	83.2	0.2	16.6	3
8	81.5	0.2	18.3	1
10	79.4	0.1	20.5	0

RT = 40

DT	%ACC	%SUB	%REJ	INS
0	96.5	1.7	1.8	22
2	96.0	1.3	2.7	17
4	95.1	0.8	4.1	8
6	93.6	0.6	5.8	7
8	91.2	0.6	8.3	4
10	88.4	0.4	11.2	3

RT = 50

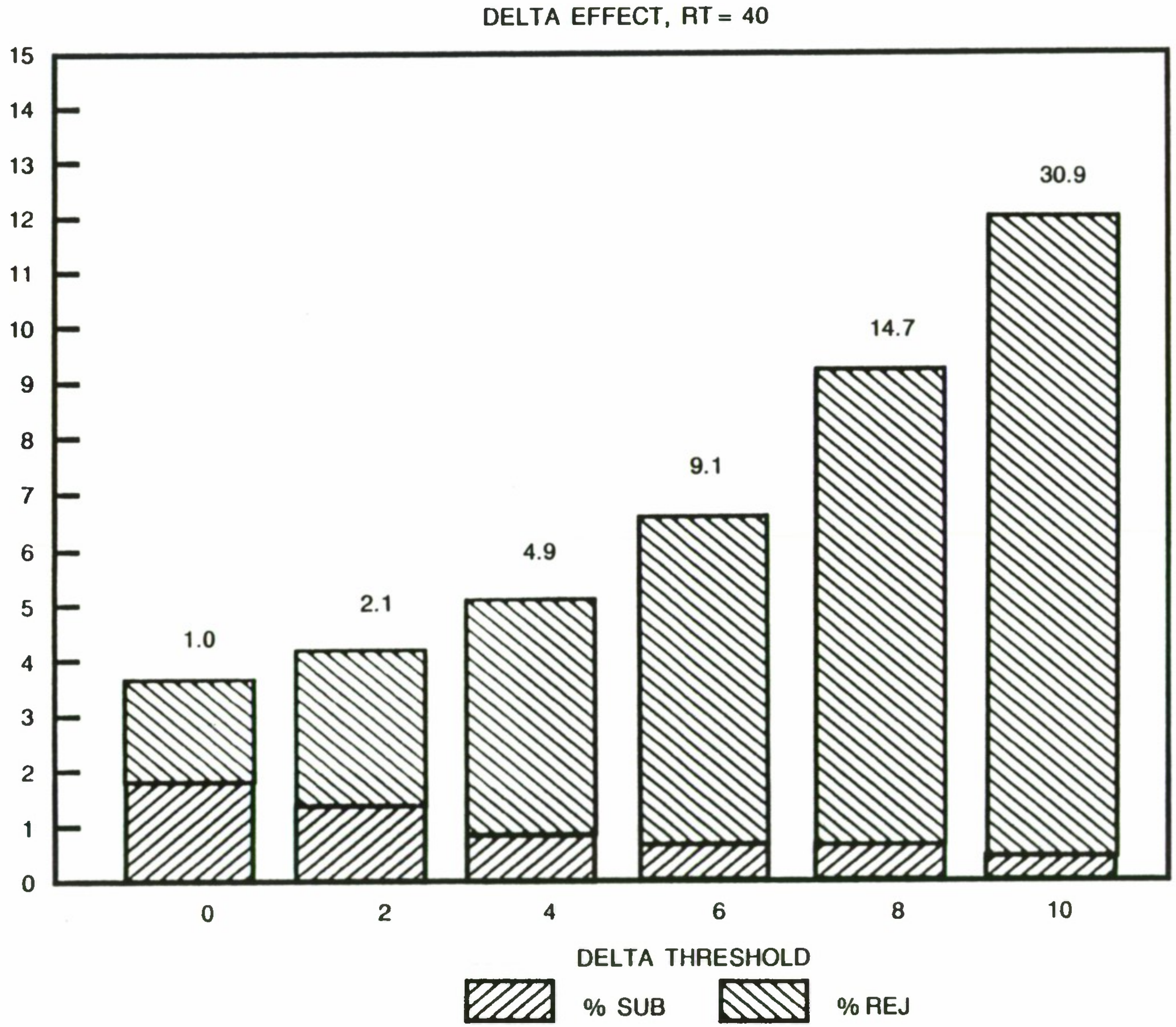
DT	%ACC	%SUB	%REJ	INS
0	97.9	1.9	0.2	49
2	97.3	1.4	1.3	39
4	96.2	1.0	2.8	28
6	94.6	0.7	4.7	25
8	91.9	0.6	7.5	18
10	89.0	0.4	10.6	13

RT = 60

DT	%ACC	%SUB	%REJ	INS
0	97.9	2.0	0.1	100
2	97.4	1.5	1.2	84
4	96.3	1.0	2.7	62
6	94.6	0.7	4.7	47
8	92.0	0.6	7.4	35
10	89.0	0.4	10.6	24

G→

VPC – 2000 EVALUATION



VPC-2000 EVALUATION

NOISE EFFECT
RT = 40, DT = 0

dB	%ACC	%SUB	%REJ	INS
97	98.5	0.8	0.7	3
106	98.2	0.9	0.9	7
112	93.0	3.5	3.5	12

G→

ATTACHMENT Q.2

Voice Interactive Systems -- Attendee List

DEPARTMENT OF DEFENSE
HUMAN FACTORS ENGINEERING
TECHNICAL ADVISORY GROUP

Voice-Interactive Systems SubTAG

Attendee List -- 7 May 1985

Mr. James C. Bach
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Director
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LT Dennis K. McBride
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Mr. Lockwood Reed
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USAF-SAM/VN
School of Aviation Medicine
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Mr. Robert (Jay) Shively
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(415) 694-6249

2 Lt. John Tester
00-ALC/MMEA
Hill AFB, UT 84056-5000
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Mr. David Williamson
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(513) 255-6696

ATTACHMENT R

DOD HFE TAG: History and Evolution -- Briefing

THE HFE TAG:
HISTORY AND EVOLUTION

NORM LANE

SAN ANTONIO, TEXAS
MAY 1985

HFE TAG

- THE CONTEXT OF ESTABLISHMENT
- EARLY DEVELOPMENT
- OTHER TAGS AND JOINT SERVICE GROUPS
- PRINCIPLES OF OPERATION AND HOW THEY GREW
- SOME ACCOMPLISHMENTS
- LESSONS LEARNED FOR LONGEVITY

THE CONTEXT OF TAG ESTABLISHMENT
(1975-1978)

- CONGRESSIONAL ATTITUDES TOWARD FUNDING
  - HOSTILITY TOWARD "HUMAN RESOURCES" AND "MANPOWER" PROGRAMS
  - PERCEIVED DUPLICATION AND REDUNDANCY ACROSS SERVICES

- TOP DOWN PRESSURES (OSD AND HQ NEEDS)
  - VISIBLE EVIDENCE OF COORDINATION
  - MECHANISM FOR SERVICE CROSSTALK
  - INPUTS FOR COORDINATION DOCUMENTS AND COLLECTIVE TECHNICAL ADVICE

- BOTTOM UP PRESSURES ("WORKER" LEVEL NEEDS)
  - OBTAIN AND SHARE TECHNICAL INFORMATION AND PLANS
  - PROVIDE FORUM FOR DISCUSSION OF COMMON/CHRONIC PROBLEMS
  - COMBINE PEOPLE AND DOLLAR RESOURCES

EARLY DEVELOPMENT

- CONCEPT OF "TAGS" FOR COORDINATION (MID '76)
- INFORMAL STRATEGY DISCUSSIONS (LATE '76)
- PAPERWORK EXCHANGE (LATE '76 - MID '77)
- FIRST MEETING AUG '77, WARMINSTER (NADC)
- T & E TAG AND WORKLOAD COORDINATING COMMITTEE FORMED EARLIER
- HF STANDARDIZATION ALREADY IN EXISTENCE AND SEPARATELY CHARTERED
- OTHER TAGS FORMED '77 & 78
- TAG CHARTER DRAFTED/APPROVED OVER FIRST 3 MEETINGS
- FORMAL OSD CHARTER IN '79

PRINCIPLES OF OPERATION
(PLANNED AND SERENDIPITIOUS)

- FOSTERING OF OPENNESS IN CONTACTS AND INTERCHANGES
  - "PROFESSIONAL" CONCERNS SHOULD SUPERSEDE "INSTITUTIONAL" ONES
  - APPROPRIATE USE OF INFORMATION OBTAINED
- EMPHASIS ON INVOLVEMENT AT LAB & CENTER LEVEL (HQ AS GUESTS)
- MAJOR WORK ACCOMPLISHED THROUGH SUBGROUP STRUCTURE
- SUBGROUP STRUCTURE DEFINED BY MEMBERS, OPERATING BOARD CONFIRMING
  - PERCEIVED NEED FOR SPECIFIC AREAS
  - WILLINGNESS OF MEMBERS TO PARTICIPATE
  - "MOTHER" TAG AS FORMAL "UMBRELLA" FOR NEW GROUPS
- LEAST POSSIBLE FORMALITY
- GROUP RUN BY PARTICIPANTS; MAXIMUM DEMOCRACY CONSISTENT WITH AVOIDANCE OF CHAOS
- OPERATING BOARD FOR CONTINUITY AND EFFICIENCY
- CONTROLLED INVOLVEMENT OF INDUSTRY & PROF. SOCIETIES FOR VARYING PERSPECTIVES
- CONTINUING CONTRACTOR "SECRETARIAT"

SOME ACCOMPLISHMENTS

- DEFUSING OF CONGRESSIONAL CONCERNS

- LONG-TERM LASTING CHANGES IN ATTITUDES TOWARD INTERCHANGE AND "COORDINATION"

- JOINT SERVICE PROJECTS

  - HFE TRAINING COURSE
  - COST EFFECTIVENESS DOCUMENTATION
  - AIDS/DAIS COORDINATION
  - PLANNING WORK FOR HEGED UPDATE
  - DEVELOPMENT OF ADVANCED THREAT AND PICTORIAL DISPLAYS
  - AF WORK ON EDUCATION OF HFE PROFESSIONALS
  - CONTINUING COORDINATION AND AWARENESS OF HF STANDARDS AND SPECS

- REEXAMINATION OF PROFESSIONAL CERTIFICATION ISSUES

LESSONS LEARNED

- WHEN IN DOUBT, KEEP IT SIMPLE

- PARTICIPATORY DECISION MAKING WHENEVER POSSIBLE

- MAINTAIN SENSITIVITY TO POLITICAL CONTEXTS, BUT MINIMIZE IMPACT ON CONDUCT OF TAG BUSINESS

- SPREAD OUT RESPONSIBILITY AND EXPERIENCE; PEOPLE CHANGE JOBS

- MAKE SURE NEW ATTENDEES UNDERSTAND THE "RULES", BOTH FORMAL AND INFORMAL

- BE PATIENT. SLOW PROGRESS MAY BE THE PRICE FOR A STRUCTURE THAT SURVIVES OVER TIME

ATTACHMENT S

Army 21 Aviation -- Briefing

ARMY 21 - AVIATION

Clarence A. Fry

U. S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD

ABSTRACT

Army 21 is a strategic and tactical operational concept for future Army operations. The tactics of Army 21 will utilize fire power and mobility to engage second echelon elements of attacking forces. The tactical concepts espoused by Army 21 places a heavy responsibility on Army aviation. The soldier-machine interface is no small part of Army aviation consideration. This paper will examine this combat environment and mission requirements while hypothesizing how next century helicopter cockpits are going to ensure successful mission accomplishment.

INTRODUCTION

The projected Army helicopter cockpit configuration of the year 2010 is entirely dependent on the tactical employment envisioned for the helicopter in Army land combat operations at that time. The cockpit design projections in this paper will be based upon presently known projections of future land combat. These projected operations rely on the mobility and fire power offered by US Army Aviation. Air-land battle concepts have as its focus, "How to fight outnumbered and win."

The tactical environment described in this paper has already caused the identification of a wide variety of Army helicopter design issues. These issues will be briefly reviewed. Indeed, a speculation on solutions to these presently-known issues will provide the foundation for a "wish list" of desired cockpit design characteristics for the Army helicopter cockpit of the year 2010.

Finally, this paper examines the major elements of aircrew activities. These activities are broadly defined as flight path and mission management functions (1). From a review of these functions, future cockpit configurations will be projected.

LAND COMBAT OPERATIONS

The Army's primary objective is to win the air-land battle. (2) To accomplish this objective, there is an ever increasing reliance placed on the mobility and firepower offered by the helicopter. The projected numerical superiority of the enemy necessitates the rapid movement of troops and equipment to engage second and third echelons of attacking enemy units. This can best be accomplished through the effective use of helicopter gunships and other helicopter mobility assets. The helicopter provides the field commander with exceptional flexibility in effectively applying his combat resources for maximum effectiveness. The effective use of airmobile assets can determine the battle outcome.

This marvelous flexibility, fire power, and mobility does come with some restrictions. These restrictions are primarily the result of highly lethal air defense (ground and air) weapon systems. The ground based air defense threat imposes a severe altitude restraint on Army helicopter operations. The Army helicopter is restricted to operating very close to the surface of the ground. The helicopter uses terrain and vegetation to mask its operation from enemy air defense. The air threat imposes a severe speed, agility, and target recognition restraint on Army helicopter operations. So what is the operating environment? Low enough to avoid enemy air defense detection and engagement. High enough to avoid collision with vegetation, terrain and man-made objects. In addition, the helicopter must be able to navigate to predetermined positions, insert troops or materiel, service targets with ordnance, and get home. This must be accomplished in day, night or adverse weather conditions.

This entire scenario is reflected in the combat crew workspace. In this case, the helicopter cockpit.

ARMY HELICOPTER AIRCREW FUNCTIONS

The aircrew functions in Army helicopter operations are very similar to the functions performed by the aircrews in other operational environments. For the sake of analysis, these functions are divided into flight-path control and mission-management functions.

The mission-management functions are often further subdivided into navigation, communication, secondary system and mission equipment. Each of these functions provided unique challenges to cockpit design in Army helicopters. A detail analysis of these challenges can be found in the Advanced Scout Helicopter Man-machine Interface Investigation (3). The simultaneous execution of these functions in critical parts of a mission causes high workload in a two-man crew. A short review of the research that relates to these issues is found in Table 1. In addition to the research identified in the table, there has been research on the utility of helmet-mounted displays for flying nap-of-the-earth missions. All of this research has been focused on increasing the probability of successfully completing a day/night/ adverse weather mission. The key parameter being addressed is the reduction of aircrew workload.

ARMY HELICOPTER COCKPIT DESIGN PROJECTIONS - How is the cockpit designer to package these stringent operational requirements in conjunction with the adverse environmental flight regime? Just what technologies might converge to deliver a product that is operationally effecitve and requires reasonable pilot workload? This section will speculate on a "dream" cockpit containing capabilities to enable effective mission execution. This analysis will again construct this "dream" cockpit design around the five key aircrew functions. These are flight control, navigation, communication, secondary systems and mission execution.

FLIGHT CONTROL - This function should be able to allow the aircrew "hands off" performance at any time during the mission. One could conceptualize a heavy dependence on artificial intelligence (AI) technology. Electroencephalogram (EEG) would be incorporated to allow the aircraft to reliably respond to aircrew-thought commands. Sensors would be available to detect wires reliably along with other hazards and obstacles. Our present MIL-STD-1295 (12) suggests

Table 1

Matrix of Representative Present Research in Army Helicopter Cockpit Design

AIRCREW FUNCTION	RESEARCH DESCRIPTION	OBJECTIVE	REFERENCE
Flight Control	Combine cyclic, collective and yaw controls into fewer controllers. Tactile feedback flight control.	Reduce workload by minimizing the number of flight control effectors. Reduce visual workload.	3, 9, 10, 11
Navigation	Ascertain navigation errors using FLIR sensor displays only. Map Displays	Determine constraints on NOE navigation imposed by limited field-of-view FLIR sensor. Present position map display effectiveness.	8
Communication	Determine the personnel performance differences using integrated radios versus separate radio heads.	Determine workload reduction when multiple radios are integrated into a single control/display system.	3, 5
Secondary Systems	All secondary systems are combined in a single display with certain display threshold logic.	Reduce cockpit management time by integrating all secondary systems information into a single control/display unit.	3, 6

that there exists five mission modes -- hover, position, transition, cruise and weapon. The AI system would sense the mission mode and sample parameters pertinent to successful execution of each mission mode enroute from staging area to target area and return.

NAVIGATION - A real-time present position map display with at least five map scales is the most critical element of this aircrew function. It could be embellished with AI features that would automatically decide the best flight routea to avoid enemy contact and expeditiously get from point to point on the battlefield. Voice recognition system commands could allow map off-aet, coordinate transformations, route of flight changes, etc. Decision aids would offer various navigational options with the respective trade-offs between transit time, enemy detection, and battle critical nature of arriving in the target area in a timely manner. Voice synthesis would present decision options in a conversational way.

COMMUNICATIONS - All frequencies would be stored by call-sign and or tactical unit. Numerical frequencies would be eliminated. Voice recognition technology would allow the aircrew to identify verbally the call-sign or identity of the tactical unit to be called. The system would automatically switch to the desired band without anything but verbal direction. The frequencies of all tactical units would be automatically changed on a master clock basis throughout the battlefield day. Visual feedback would list the tactical units by designator or call-sign instead of frequency.

SECONDARY SYSTEMS - All secondary system parameters (engine, electrical, hydraulic, etc.) would be conveyed by synthesized voice or visual displaya. Sensora would ascertain through AI onset threshold criteria potential system failures before they occurred. Trouble shooting and in-flight corrective action would be provided through decision options to the aircrew. Once a given decision option was aelected, then the system architecture would effect an automatic implementation of that action. Routine sampling by the aircrew of any secondary system parameter may be accomplished by asking the system for the desired parameter. The value(s) will be available in both auditory and visual displays. Time history recording are available for selected periods of the flight for maintenance analysis after the flight. Anytime a secondary system goea out of limits in flight, the onset and out-of-limits condition are automatically recorded for that parameter and other interdependent parameters.

MISSION EXECUTION - For this function, sensora and battlefield intelligence provide ideal ambush locationa for anti-tank gunship operations. Hands-off hover at altitudes that provide needed intervisibility while minimizing the probability of enemy detection will be automatic. Positiona will be automatically within weapons range. The weapons will be self-guided with passive sensor. The sensor will have automatic target recognition systems. They may be fired from behind a hill mass without direct target to weapon visibility at launch. The weapon will be capable of acquiring the target in flight and use passive terminal homing to destroy it. Blade clearances are automatically accounted for in either firing position or troop/equipment insertion operations. Decision aids provide alternate firing positions with trade-offs in effectiveness when choosing one or another.

GENERAL CONFIGURATION

The cockpit would be designed for "shirt sleeve" operations. Protection would be available from chemical/biological (CB) agents, radioactive, laser, etc. Means would be available for ingress and egress from "dirty" CB or radioactive environments. Craah attenuation would ensure survival from all but the most devastating aircraft accidenta or combat loss.

The crew station will be totally enclosed. There will be no transparenciea. All visual reference to the outside world will be via sensors of high resolution (equivalent to the eye) and wide field-of-view (180°H x 45°). Lightweight panaromic helmet display will provide the primary medium.

Emergency egress is provided to each crew member and passenger. Each seat would be packed with automatically deployed motorized hang gliders. Airborne emergency egress will be through ejection seats.

SUMMARY AND CONCLUSION

An Army perspective ia presented here in the "ideal" Army helicopter cockpit of the future. A summary of the tactical neceasities which drive cockpit design ia reviewed. A short summary of present day helicopter cockpit research is reviewed. Finally, extensive projections are made summarizing the characteristica of the "dream" Army helicopter cockpit of the year 2010 time frame.

The "dream" Army helicopter cockpit of the future is heavily dependent on continued development of artificial intelligence technology. The application of these technologies required continue development of accurate sensors and display medium.

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US ARMY HUMAN ENGINEERING LABORATORY

AVIATION AND AIR DEFENSE DIRECTORATE

HEL

ARMY 21 - AVIATION

PRESENTED BY

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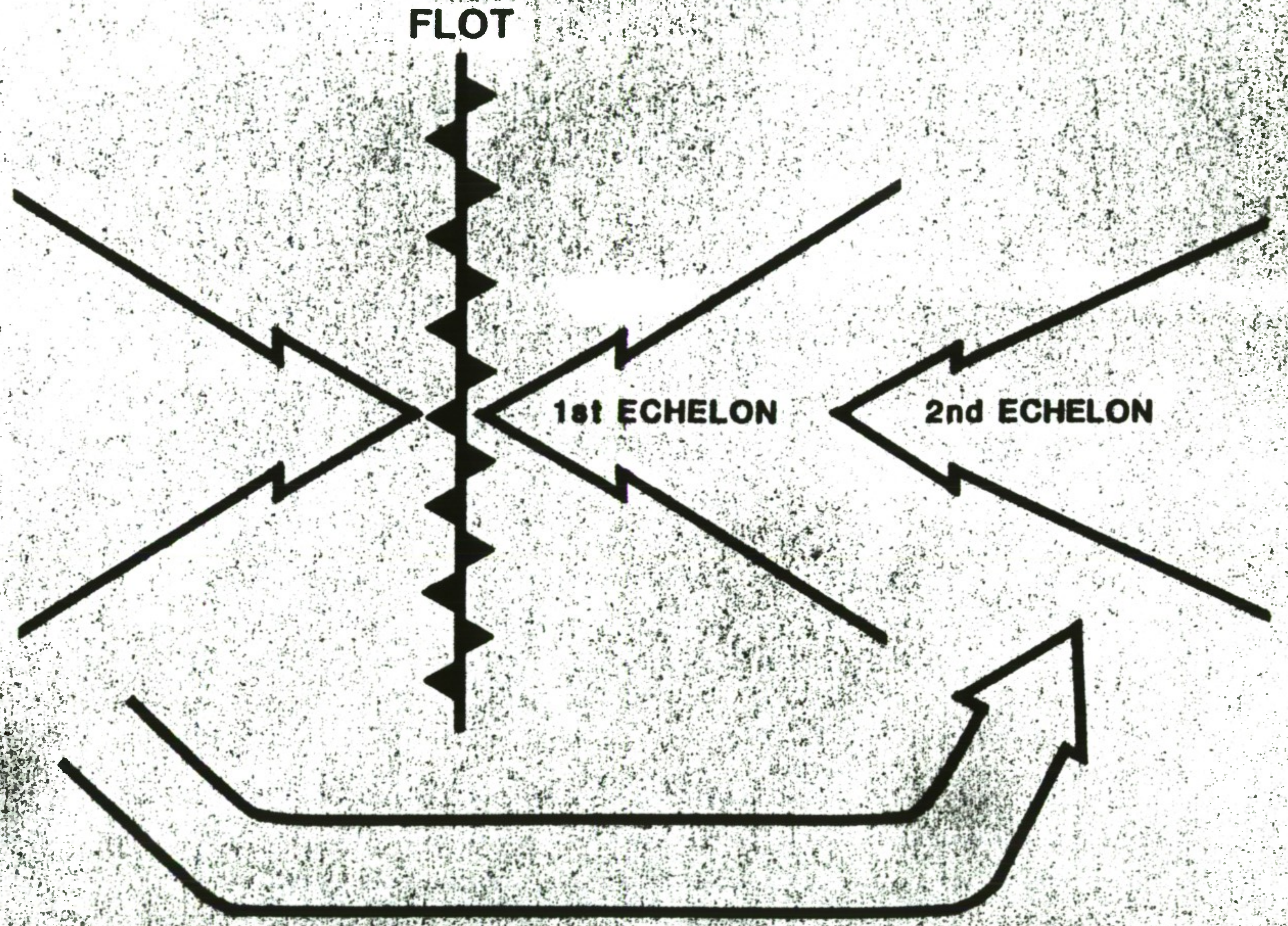
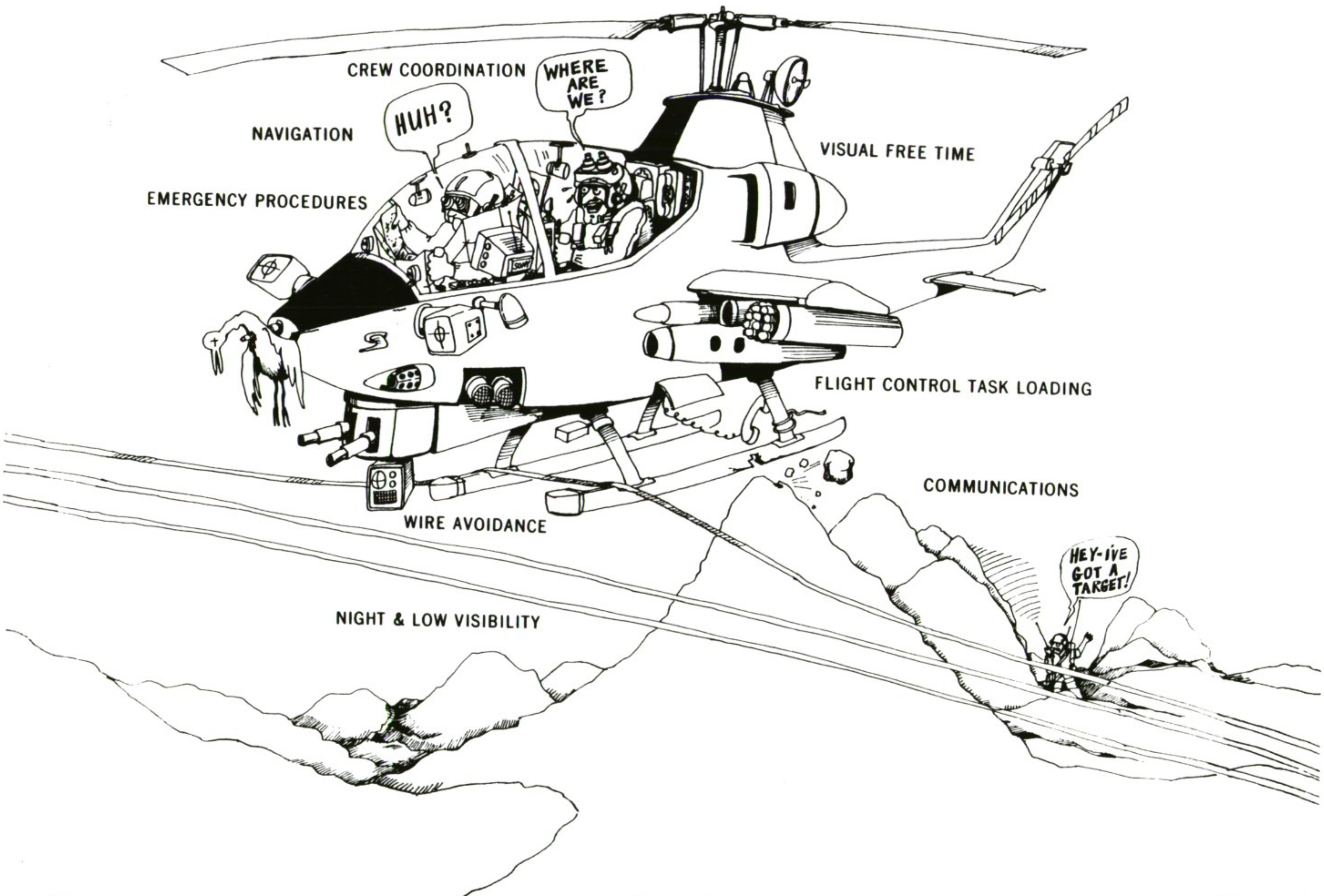
ARMY 21 - AVIATION



NAP-OF THE-EARTH FLIGHT PROBLEMS



HELICOPTER COCKPIT DESIGN PROJECTIONS

FLIGHT CONTROL

- HANDS OFF HOVER
- AUTOMATIC POP-UP
- AUTOMATIC WIRE AVOIDANCE

NAVIGATION

- REAL TIME POSITION
- 50 METER ACCURACY
- FIVE MAP SCALES
- AI ON THREAT
- VOICE COMMAND FOR TRACK UP/NORTH UP ETC.

HELICOPTER COCKPIT DESIGN PROJECTIONS

COMMUNICATIONS

- AUTOMATED CEOI
  - MASTER CLOCK
  - UNITS FREQUENCIES

SECONDARY

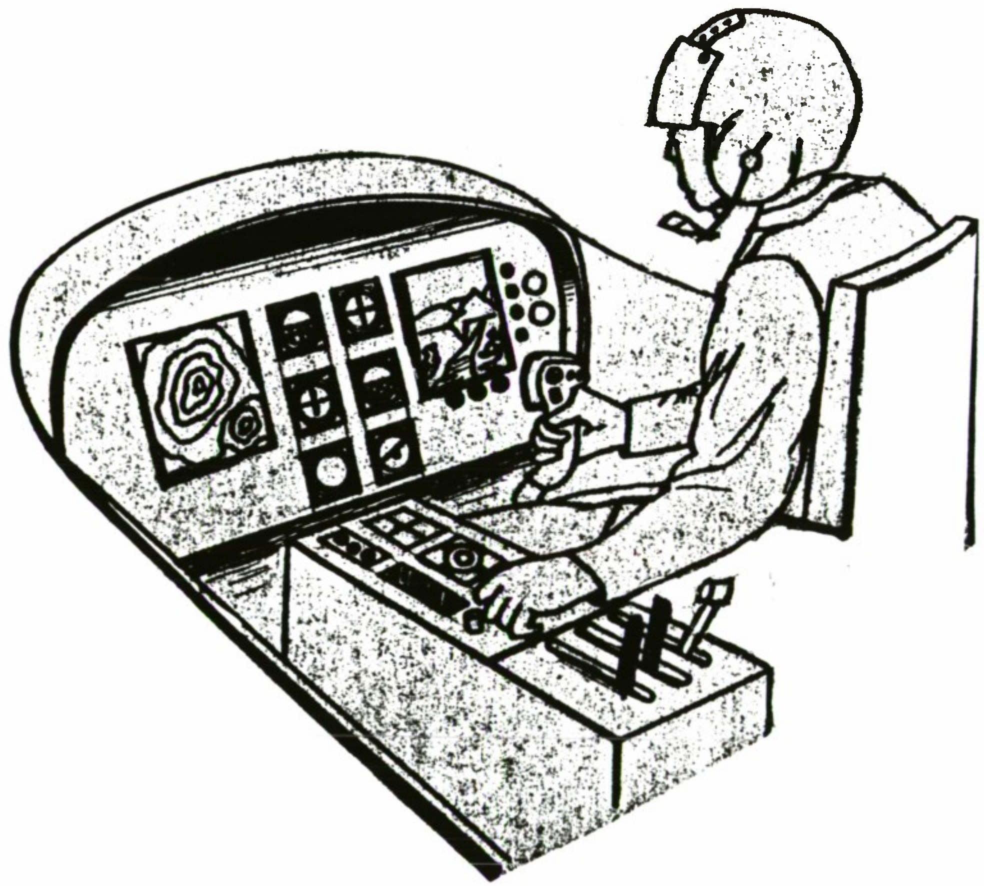
- SYNTHESIZED VOICE
- FAULT ANALYSIS ON SYSTEM MALFUNCTIONS
- DECISION AIDING ON MALFUNCTIONS
- TIME HISTORY OF PARAMETERS SENSED FOR MAINTENANCE
- AUTOMATIC RECORDING OF OUT-OF-TOLERANCE CONDITION

HELICOPTER COCKPIT DESIGN PROJECTIONS

MISSION EXECUTION

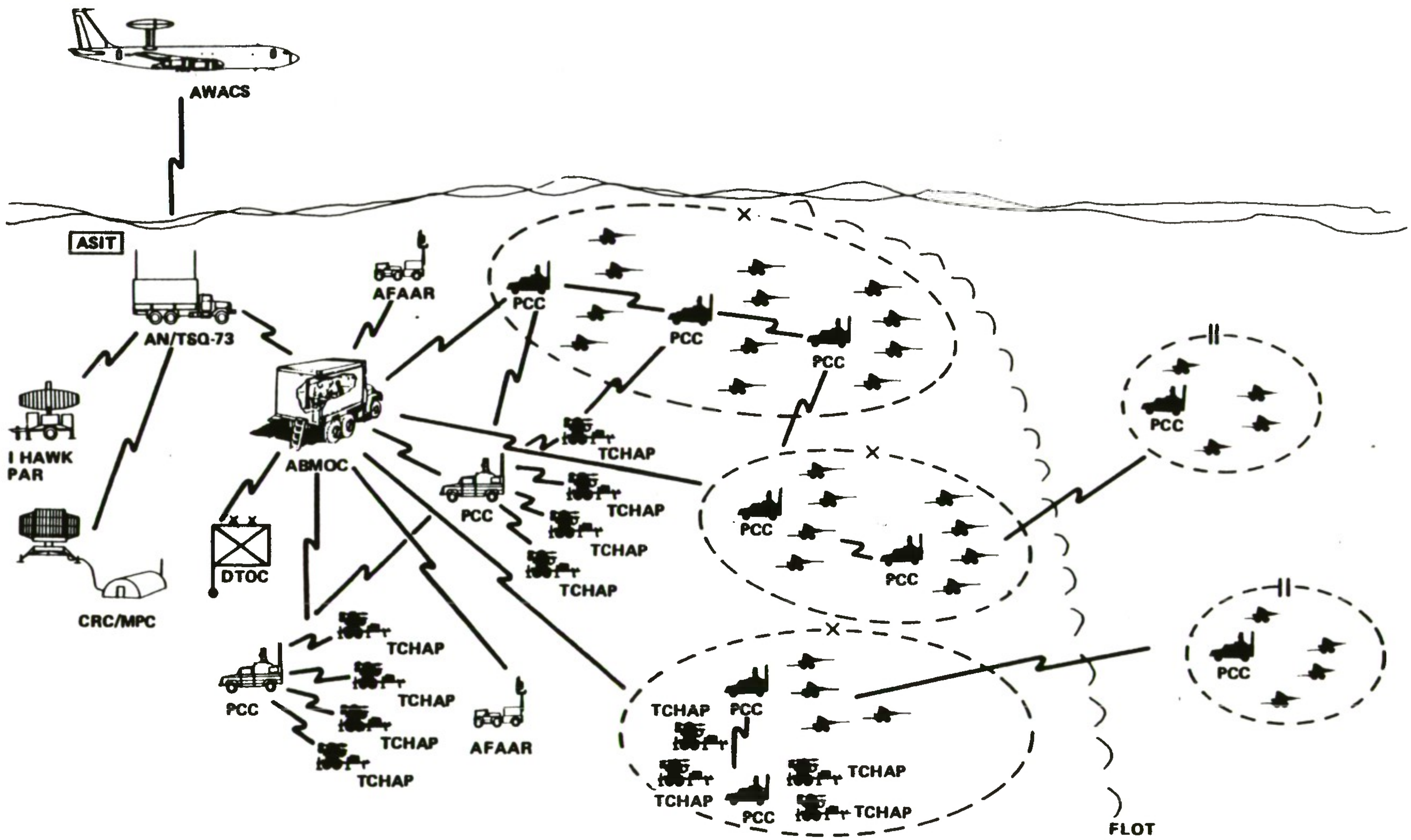
- DECISION AIDS TO IDENTIFY ENEMY FORCE, LOCATION AND MOVEMENT
- PROVIDE ATTACK LOCATIONS
  - WITHIN WEAPONS RANGE
  - SENSOR AUTOMATICALLY ON TARGET ON UNMASK
  - TERMINAL HOMING
- AUTOMATIC BLADE CLEARANCE FOR TROOP INSERTION IN CONFINED AREAS
- SHIRT SLEEVE NBC PROTECTION
- WIDE FOV SENSORS
- MOTORIZED HANG GLIDER ESCAPE SYSTEM

HELICOPTER COCKPIT DESIGNS



USAHEL
DIGITAL AIR-TO-AIR MAP
(HELDATAM)

SHORAD C²



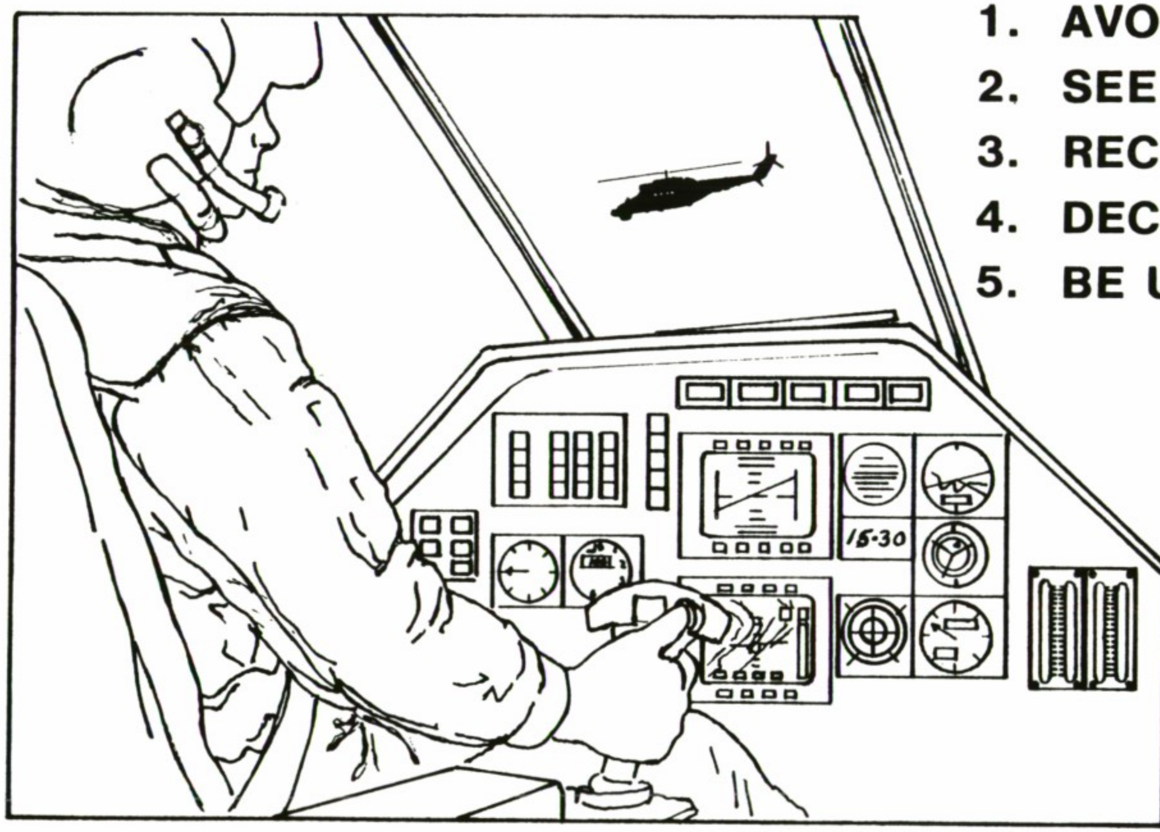
AWACS
ASIT
AN/TSQ-73
I HAWK PAR
CRC/MPC
AFAAR
ABMOC
DTOC
PCC
TCHAP
AFAAR
FLOT

SHORAD C^2

PROVIDES A REAL-TIME PICTURE OF:

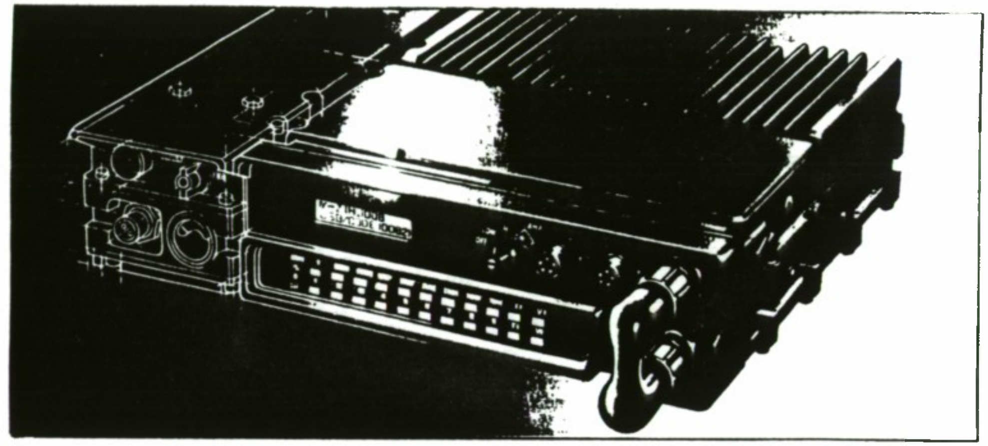
1. ALL SENSED AIRCRAFT WITHIN THE DISPLAY AREA
2. IDENTIFICATION OF FRIENDLY, ENEMY, AND UNKNOWN AIRCRAFT
3. CURRENT BATTLEFIELD GEOMETRY
4. CURRENT AIR DEFENSE WARNINGS AND AIR DEFENSE WEAPON CONTROL ORDERS
5. AVIATION GROUND CONTROL MEASURES
6. LOCATION OF MAJOR UNITS AND FRIENDLY AIR DEFENSE

PRINCIPLES OF AIR-TO-AIR COMBAT (TC 1-112)



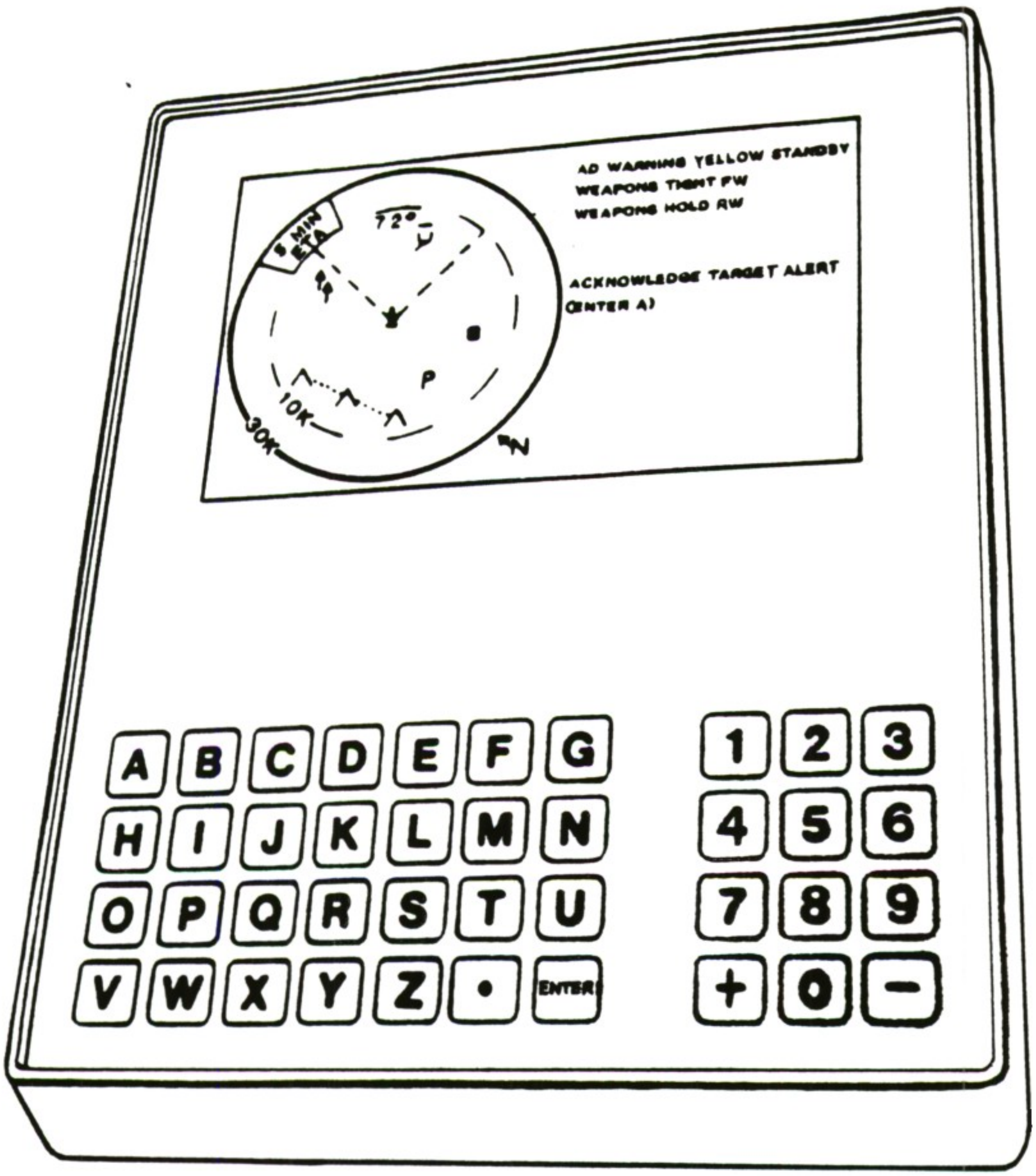
1. AVOID DETECTION
2. SEE THE THREAT FIRST
3. RECOGNIZE THE THREAT
4. DECIDE TO ENGAGE -- FIRE FIRST
5. BE UNPREDICTABLE

PJH→



←ONBOARD DIGITAL MAP

SHORAD C^2 TEST DISPLAY DEVICE



ATTACHMENT T

Computer-Based Tools for Cockpit Design -- Briefing

COMPUTER-AIDED DESIGN AND ANALYSIS OF WORKSTATIONS

A USER FRIENDLY SYSTEM

(presented DoD HFE TAG)

The Crew Systems Development Branch, of the Air Force Wright Aeronautical Laboratories' Flight Dynamics Lab, has been supporting an in-house program since 1981, which is making available to our engineers and psychologists an integrated package of computer based cockpit design and analysis tools.

First, I would like to review the advantages afforded by computer-aided design and evaluation techniques, or CADETs as I'll refer to them, then discuss the approach we used to establish our package of tools, and what CADETs we have included initially, in our system. I will then discuss our approach to the design of the key component of our system -- the user-computer interface. Finally, I will highlight what we perceive as the direction computer-aided design, in general, is heading, and what additional development we have identified for our computer-based system.

Aircraft cockpits have evolved and will continue to evolve, as shown by this series of slides (Fig. 2-5), into sophisticated workstations requiring the consideration of many human factors (Fig. 6) issues if the pilot-vehicle interface is to be most effective. To address these issues, the Crew Systems Development Branch (Fig. 7) evolved a logical, structured process using full-scale mockup evaluations, during preliminary design, to consider design alternatives.

These, and other preliminary design methods are generally effective, but require, as in the case of the mockups (Fig. 8-9) considerabled expenditure of resources, and can take months to apply (Fig. 10).

Computer-aided design methods, on the other hand, (Fig. 11) have attractive benefits for preliminary design.

They can save time and money by eliminating the lengthy mockup evaluations, they permit design iterations to be evaluated much more rapidly, and they typically produce quantitive results -- All of which contribute to a higher level of design confidence being achieved during preliminary design. And (Fig. 12) as shown on this chart, numerous computer-based methods, relevant to human factors issues, have been developed. (Fig. 13) Our project goal was to identify and implement specific computer-based human factors design and evaluation tools that would blend into our existing, structured, process. In other words, we wanted to maintain the types of analyses performed using our current process and only modify the method or tools by which these analyses were performed.

In order to learn from other's experiences, we began our project by holding a workshop at Wright-Patterson Air Force Base, which brought together many key individuals experienced in the development and application of the types of CADETs we were interested in. Those discussions were the basis for our CADET system concept (Fig. 14) which is a collection of computer-based design and analysis tools, all accessible through a single computer terminal. (Fig. 15) We established four main objectives for our CADET system. First, we decided to implement design and analysis tools that had been previously developed and were available for minimal cost. Second, we wanted a modular approach. Third, we wanted to minimize the number of host computers. And fourth, and most important, the user-computer interface had to be uncomplicated.

Off-the-shelf tools were chosen in order to reduce software development costs and expedite availability of the tools to the designers. These tools are the Crewstation Assessment of Reach model, or CAR, the Human Operator Simulator, or HOS, and the System Analysis of Integrated Network of Tasks modeling language, or SAINT.

I will say more about these tools, along with our Display Format Design Tool and Panel Layout Design Tool, later.

A modular design approach was selected in order to keep each tool physically separate and independent from the others. In this manner, an individual tool can be replaced, modified, or added without affecting any of the tools.

Minimizing the number of host computers was desired for two reasons. One, it reduces the administrative burden of account numbers, passwords, etc., and equipment maintenance. Two, centralizing all the tools on as few computers as possible simplifies the programmer's task by involving as few control languages as possible.

An uncomplicated user-computer interface was desired in order to standardize the procedure to access a tool through our terminal and at the same timed keep the host computer transparent to the user. I will describe our user-computer interface approach in more detail. but I would first like to go back and briefly cover the design and analysis tools we are implementing, and our system hardware.

(Fig. 16) As depicted in this block diagram representation, we have a total of five tools and three data bases in our current system design.

The Panel Layout Design Tool, represented by the dashed box, because we have not implemented this yet, is intended to be a graphics design tool used to create panel layout concepts.

The Display Format Design Tool, which was developed in-house to take full advantage of our intelligent color graphics terminal, allows designers to conceptualize display formats, symbol placement, information content, and color coding alternatives prior to dynamic evaluations. Completed formats can be stored in the Display Format Data Base, for later recall. Also, components of a display may be stored individually in order that a format can be constructed from previously drawn pieces of a display.

Our Reach Analysis Tool is a version of the computerized assessment of reach, or CAR, model. CAR generates an operator sample from an anthropometric data base and using a specified workstation geometry analyzes an operator's reach envelope, and computes the percentage of operators able to reach specified controls. CAR also checks to verify body clearances relative to the geometry.

Our Workload Analysis Tool uses the human operator simulator model, or HOS, which has sub-models of operator perceptual, cognitive, and motor functions.

The designer describes the operator procedures, how the controls and displays function, and the equipment layout. HOS computes the time to perform each procedure and the output includes a summary of the sequence of procedures, a control and display usage analysis, and a loading analysis of the proportion of the total time each hand, foot, etc. is occupied in a task.

Our System Modeling tool is the system analysis of integrated networks of tasks (SAINT) modeling language, specifically developed to assist in the design of human-machine systems. SAINT depends on a designer-generated model of the system consisting of task elements, system resources, and their interactions. This tool allows the assessment of the effect of the component's characteristics on overall system performance. Output data from SAINT include summary statistics on resource utilization and task performance.

(Fig. 17) The system hardware utilized in our design consists of two host computers with disk storage - The Cyber 750 with a NOS operating system is the host for our workload analysis tool. The VAX 11/780, with a VAX/VMS 4.0 operating system is the host for all other software. (Fig. 18) Our workstation consists of an Envision model 230 advanced color graphics terminal, an Envision model 420 dot-matrix printer, and a digitizing tablet with a programmable mouse.

A system of computer-based techniques can have undesirable qualities, with regard to the human-computer interface, which must be overcome. Using multiple software packages can result in different approaches to interface design regarding accessing the tool, entering commands, and other on-line functions associated with the various tools. Also tools hosted on different computers can have different log-on procedures. Further while most designers using our CADET system are familiar with the tools and the resulting data, few are computer experts. To overcome these problems, (Fig. 19) a user-computer interface was needed which standardized the method of logging-on the CADET system and accessing the tools, and which was easy to learn and use.

Our CADET system User-Interface Module (Fig. 20) is a menu-based interface. After initially logging-on the VAX computer, the user is prompted to select from the Main Menu. This menu allows the user to select one of the tools or to select a utilities menu to rename, delete, print files, etc. After selecting a tool, a menu of tool-specific functions (Fig. 21) is then displayed, from which the designer makes a selection.

We have also designed an alternative method which is available for the experienced user. Following log-on, the user can by-pass the main menu and technique menu and immediately select a specific tool function. This expert path can thus reduce the number of entries a user must go through to access a desired tool, from four entries to one.

I've described one of many possible approaches to a computer-based system of human factors design and analysis tools, and although our User Interface Module design, and tools, have been accepted by our designers, there are several existing and forthcoming capabilities (Fig. 22) to pursue in the future, that would improve our system.

First, 3-D graphics is of interest because our Reach Analysis Tool uses cockpit geometry data from a 3-axis coordinate system. A 3-D graphics capability could be used to draw reach envelopes on workstation panels. 3-D graphics could also be used with the Display Format Design Tool to animate display formats.

Second, while we have the goal to keep the tools separate for software maintenance purposes, it is desirable for the tools to share data bases and data files, in order to eliminate the need for the designer to transfer data by hand.

Third, the design and analysis tools we have selected, address only a subset of the design issues relevant to workstation design. Recognizing this, we are monitoring the development of mission analysis methods, function allocation methods and others that would assist the design process.

Fourth, some tools similar in capability to those in our system have been written to run on microcomputers. Continued developments in this area could result in a true desktop workstation.

Also, a voice interactive workstation is another capability that, if properly applied, would greatly improve the user-computer interface.

To summarize, then, (Fig. 23) our research, development, implementation, and application of computer-based design and analysis tools has demonstrated they have a definite place in the design process, there are numerous tools available to select from, and a system of computer-based tools is practical if its tailored to the application and to the user, if its structured so tools may be easily added, deleted, or replaced, and if its recognized that a continual need exists for software implementation and maintenance.

COMPUTER-AIDED DESIGN AND ANALYSIS
OF
WORKSTATIONS
(A User-Friendly System)

BY

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CADET

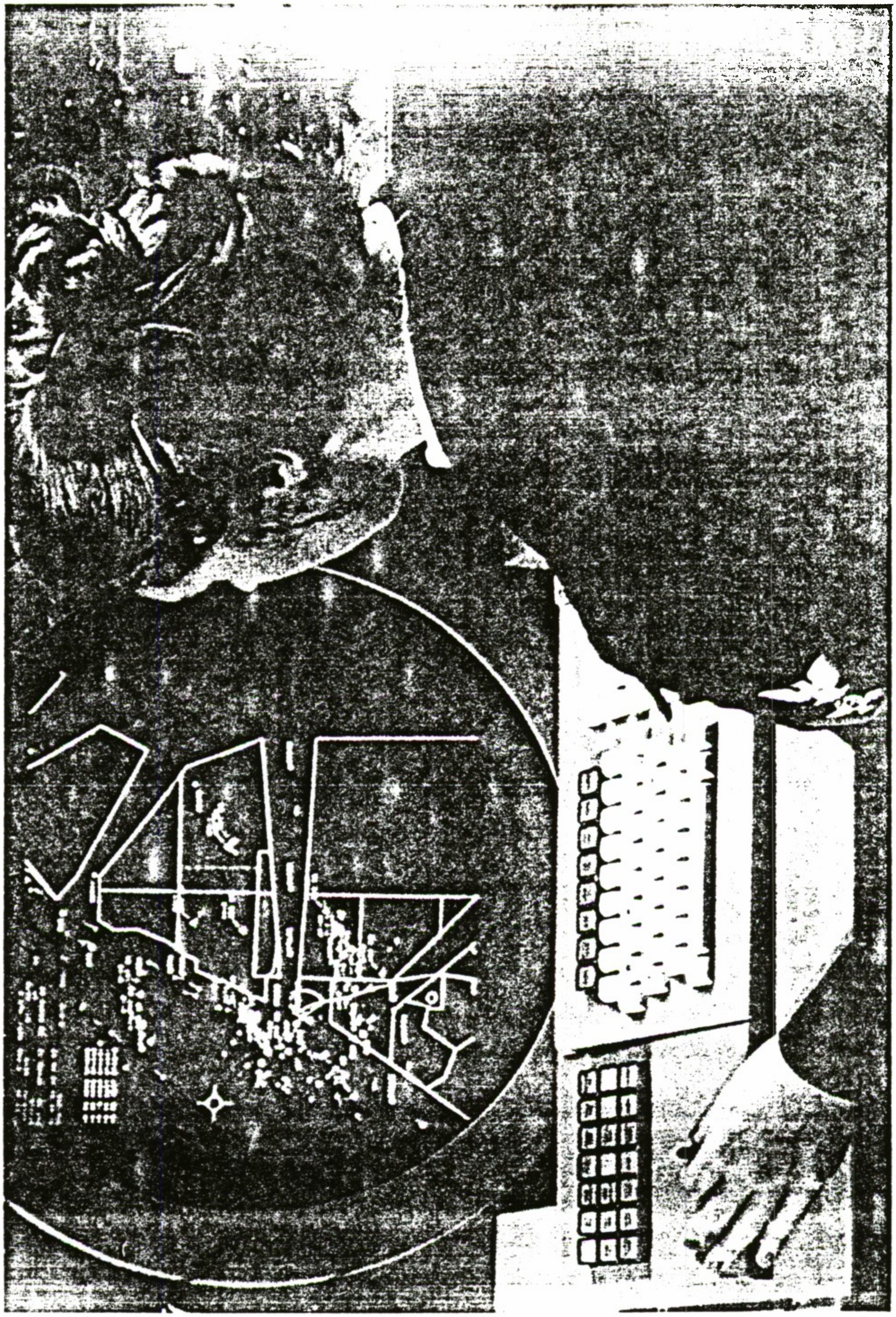
OUTLINE

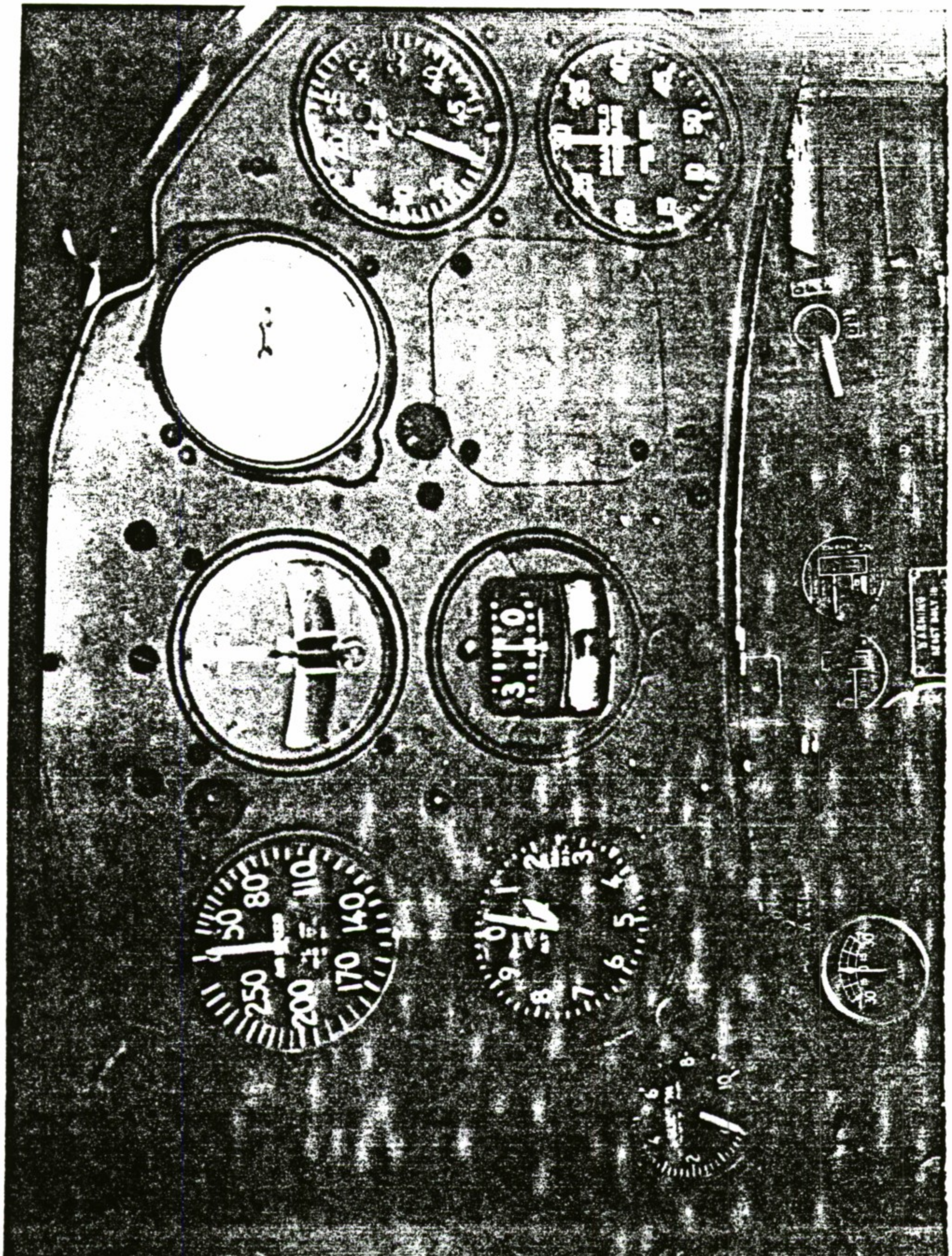
WHY— the advantage of CADETs

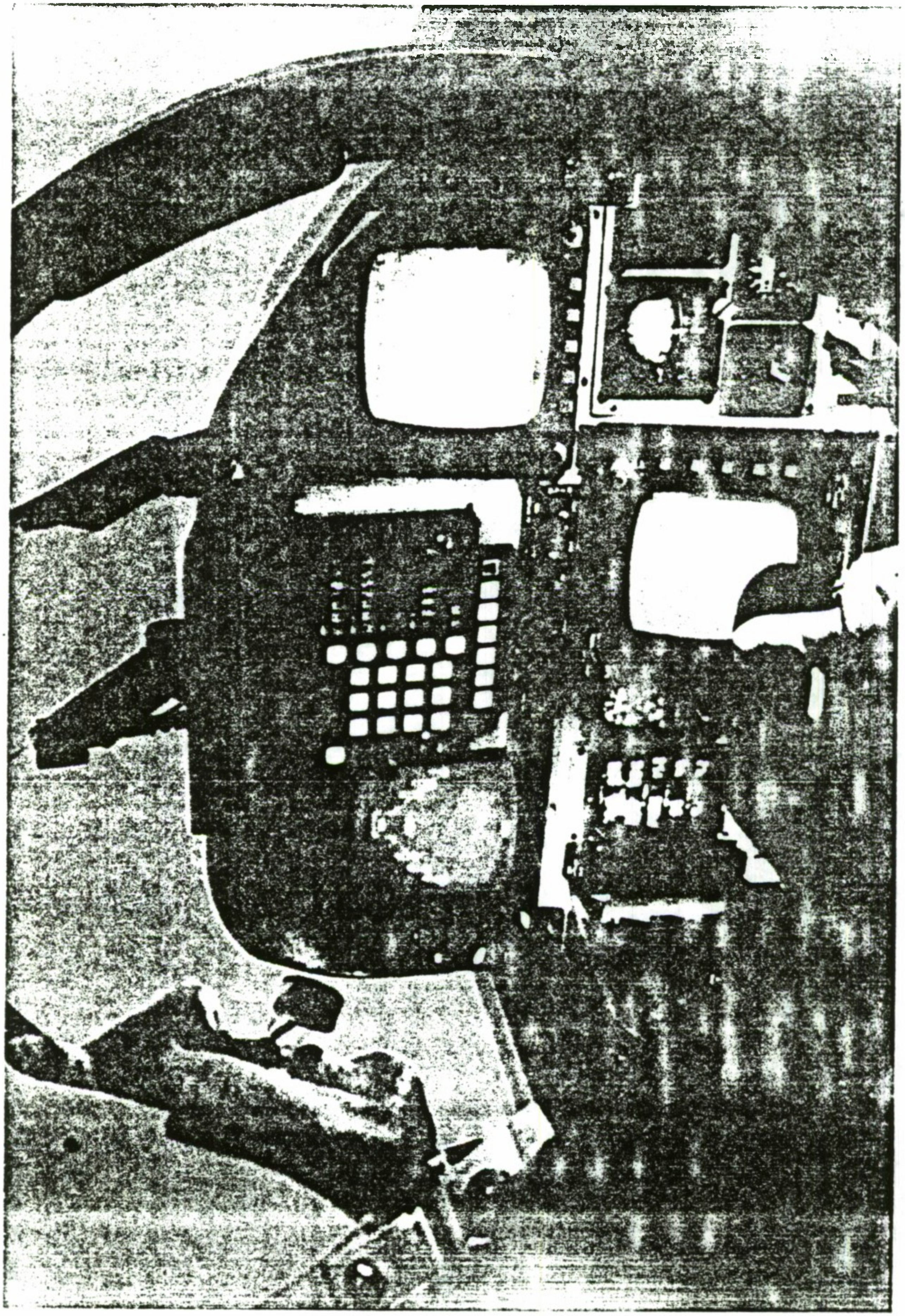
WHAT— CADETs available

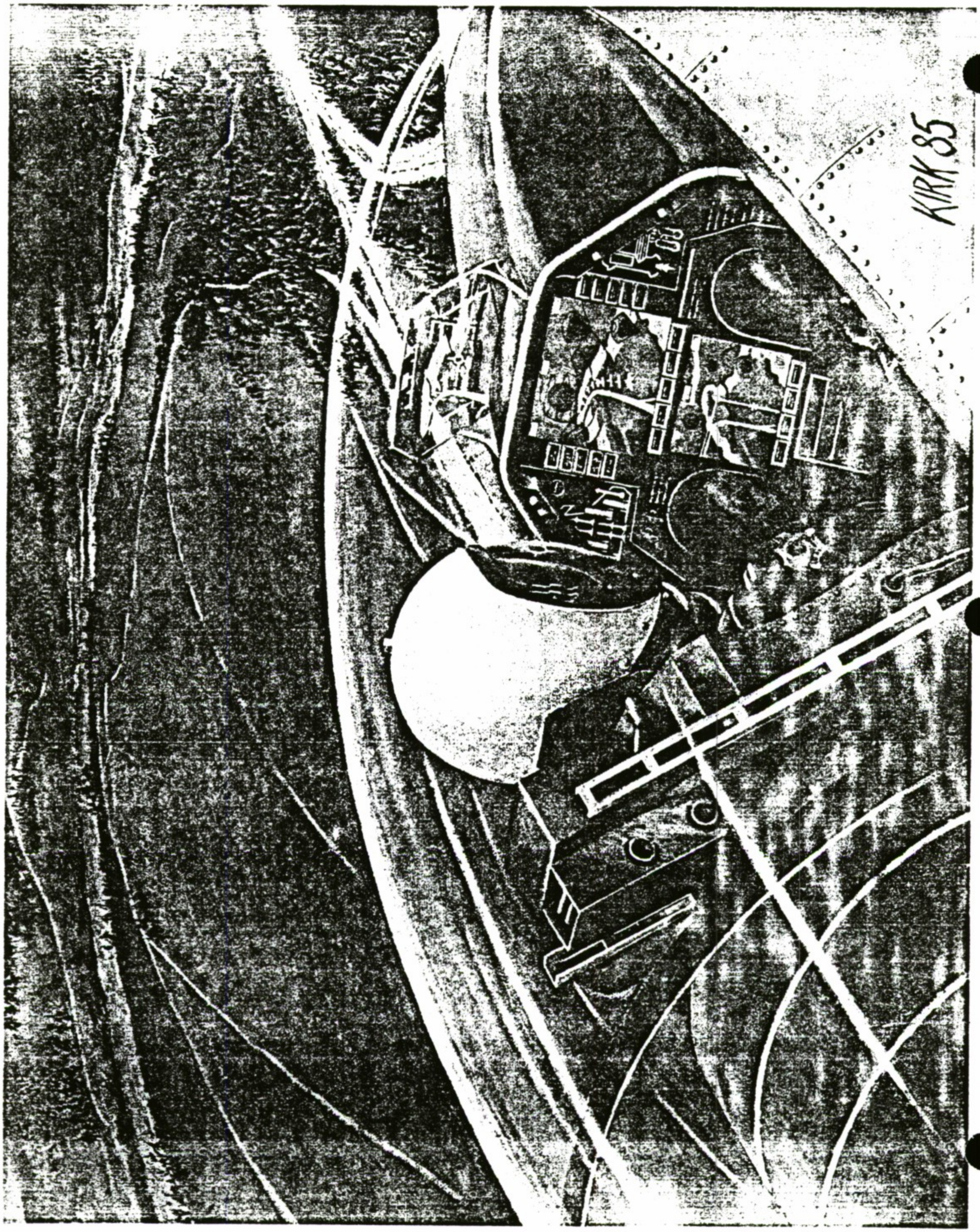
HOW— the user-computer interface

WHERE— future directions of CADET








KIRK 85

CADET

HUMAN FACTORS DESIGN ISSUES

INFORMATION REQUIREMENTS

CREW PERFORMANCE

COCKPIT GEOMETRY

TASK ALLOCATION

MAINTAINABILITY

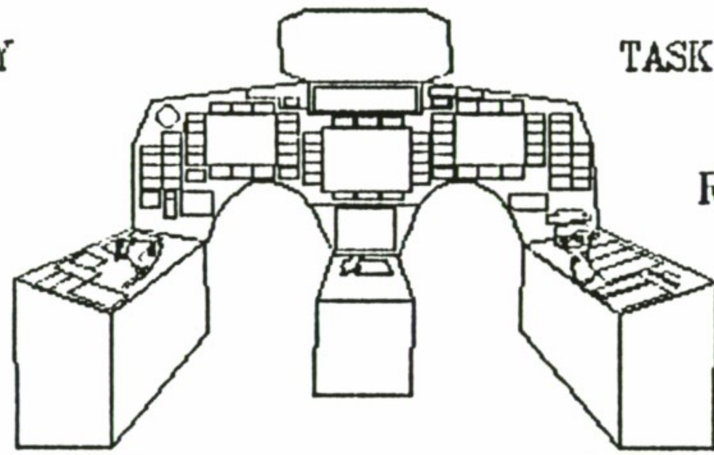
REACH ENVELOPE

CREW SIZE

TRAINING

PANEL LAYOUT

RELIABILITY



LIFE CYCLE COST

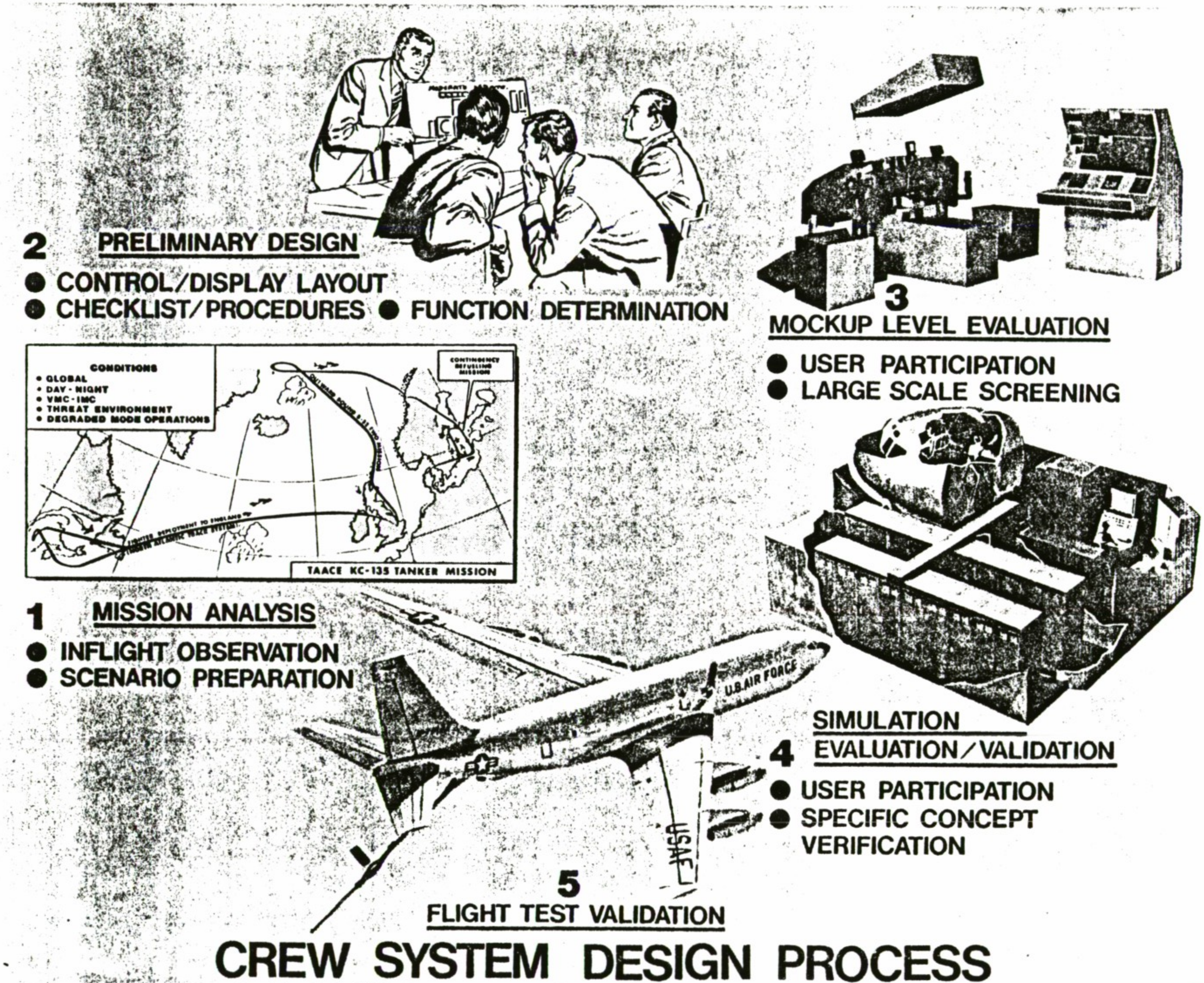
CREW WORKLOAD

CONTROL/DISPLAY MODE

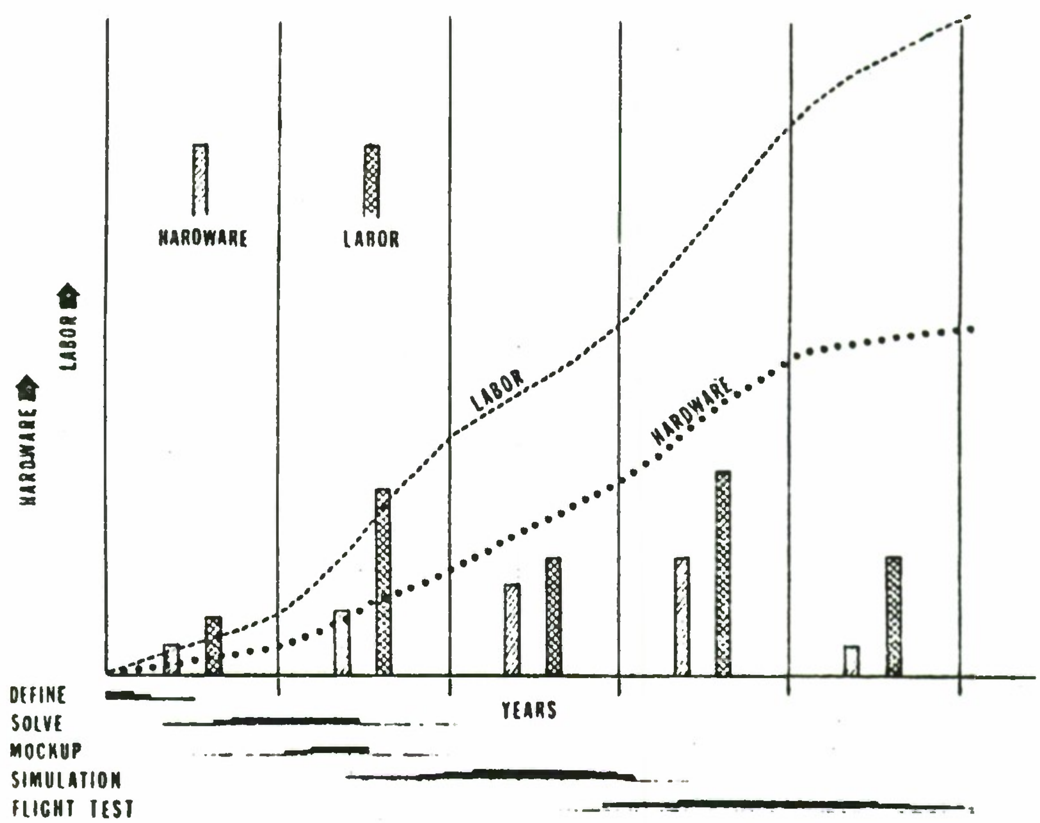
FUNCTION ALLOCATION

VISION ENVELOPE

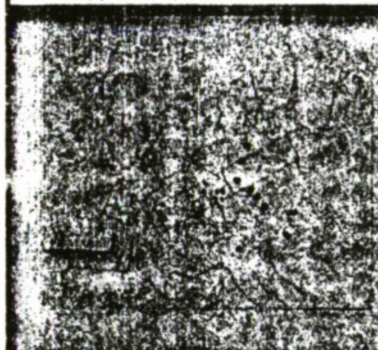
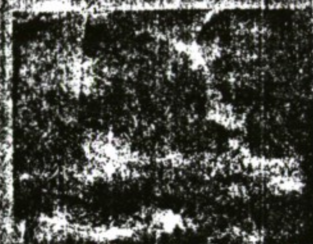
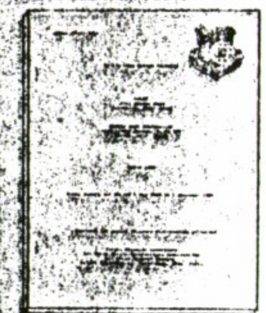
DISPLAY FORMAT



2 PRELIMINARY DESIGN
● CONTROL/DISPLAY LAYOUT
● CHECKLIST/PROCEDURES ● FUNCTION DETERMINATION
CONDITIONS
• GLOBAL
• DAY - NIGHT
• VMC - IMC
• THREAT ENVIRONMENT
• DEGRADED MODE OPERATIONS
CONTINGENCY REFUELING MISSION
TAACE KC-135 TANKER MISSION
1 MISSION ANALYSIS
● INFLIGHT OBSERVATION
● SCENARIO PREPARATION
3 MOCKUP LEVEL EVALUATION
● USER PARTICIPATION
● LARGE SCALE SCREENING
4 SIMULATION EVALUATION/VALIDATION
● USER PARTICIPATION
● SPECIFIC CONCEPT VERIFICATION
U.S.AIR FORCE
USAF
5 FLIGHT TEST VALIDATION
CREW SYSTEM DESIGN PROCESS


HARDWARE
LABOR
LABOR
HARDWARE
HARDWARE
LABOR
YEARS
DEFINE
SOLVE
MOCKUP
SIMULATION
FLIGHT TEST

CREW SYSTEM DESIGN PROCESS

CREW SYSTEM REQUIREMENT DEFINITION	CREW SYSTEM DESIGN DEFINITION	CREW SYSTEM DESIGN TESTING	CREW SYSTEM DESIGN VALIDATION	CREW SYSTEM DESIGN SPECIFICATION
				
• IN-FLIGHT OBSERVATION • QUALITATIVE ANALYSIS • QUANTITATIVE ANALYSIS	• DESIGN HDBK • PILOT OPINION • COMPUTER GRAPHICS	• PART-TASK • EXPERIMENTER OBSERVATION • PILOT OPINION • PILOT RATING • COMPUTER MODELS	• PRIMARY TASK • SECONDARY TASK • EXPERIMENTER OBSERVATION • PILOT OPINION • PILOT RATING	• CREW SIZE • SUBSYSTEMS • INFO REQTS • INPUT REQTS

G→

CADET

BENEFITS OF CAD

- PRELIMINARY DESIGN IS

MORE . . . EFFICIENT

. . . EFFECTIVE

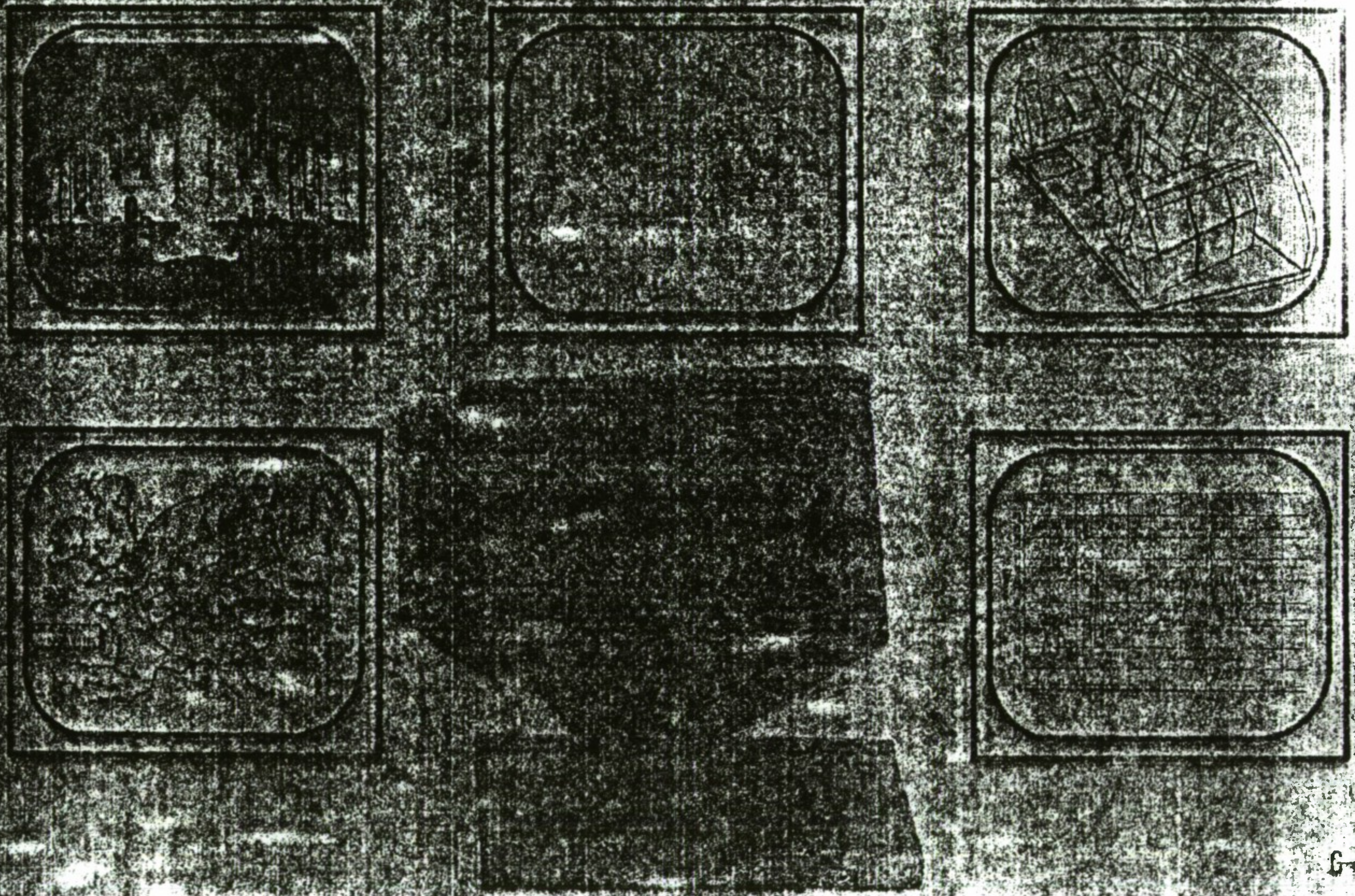
. . . QUANTITATIVE

. . . CONFIDENT

COMPUTER-AIDED DESIGN AND EVALUATION TECHNIQUES

CREW SYSTEM REQUIREMENTS DEFINITION	CREW SYSTEM DESIGN DEFINITION	CREW SYSTEM DESIGN TESTING	CREW SYSTEM DESIGN VALIDATION	CREW SYSTEM DESIGN SPECIFICATION
CISMS	BIOMAN	CAFES (WAM)		
SADT	CADAM	CATTS		
CAFES (FAM)	BOEMAN	CISMS		
	CAFES (CGE)	CODEM		
	CAPE	DSM		
	CAR	HOS		
	COMBIMAN	ORACLE		
	CORELAP	PROCRU		
	HECAD	PSM		
	CRAFT	SAINT		
	LAYGEN	SBO		
	CREVS	SWAM		
	CUBITS	TAS033		
	HOS	TEPPS		
	PANEL	THERP		
	SAMMIE	TLA		
	WOLAP	TX105		
	PLAID	MOPADS		

[illegible]PLEMEN[illegible]R AIDED [illegible] AND [illegible]



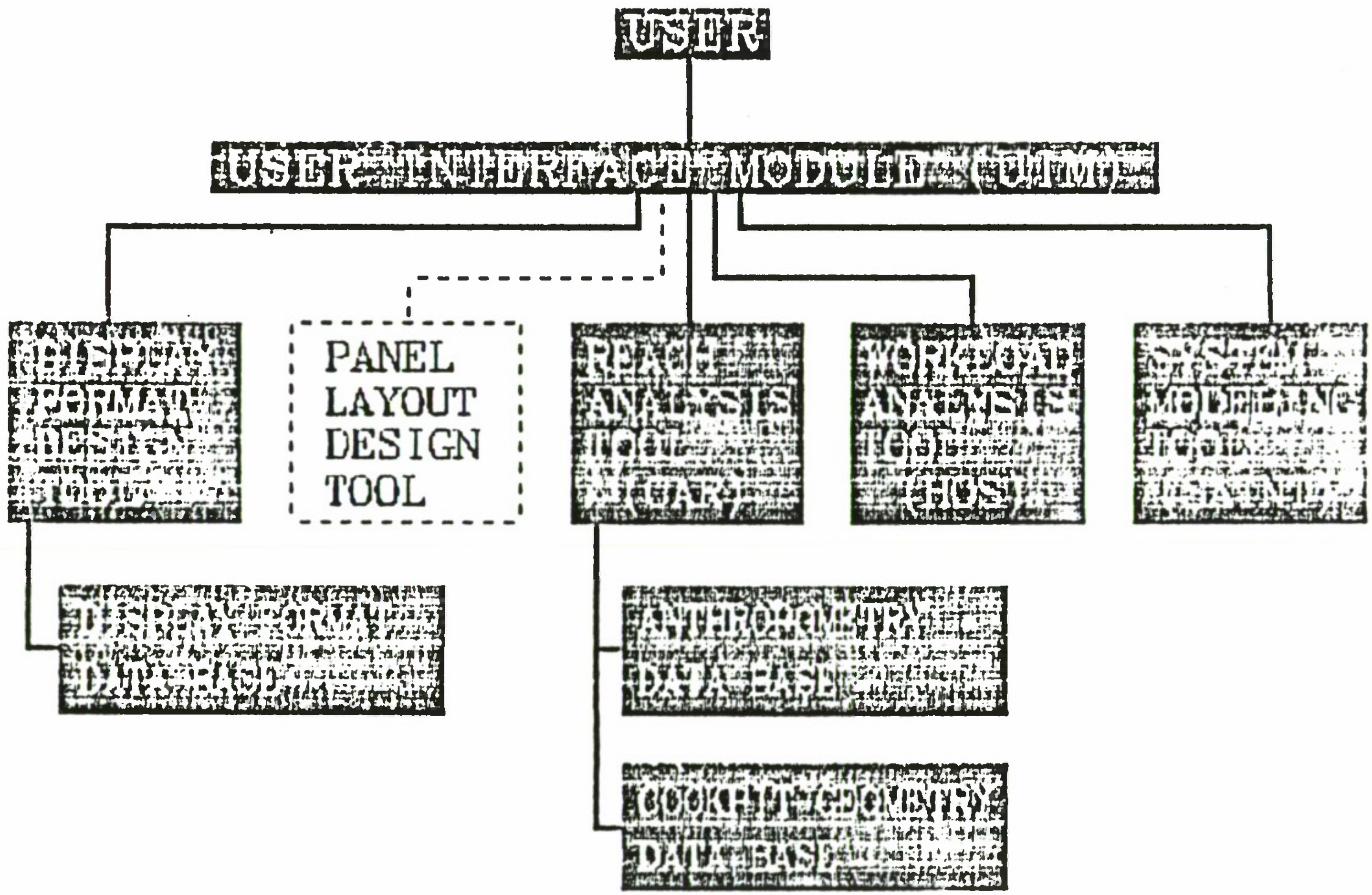
CADET

SYSTEM OBJECTIVES

- "OFF-THE-SHELF" TOOLS
- MODULAR STRUCTURE
- MINIMAL HOST COMPUTER USE
- USER FRIENDLY

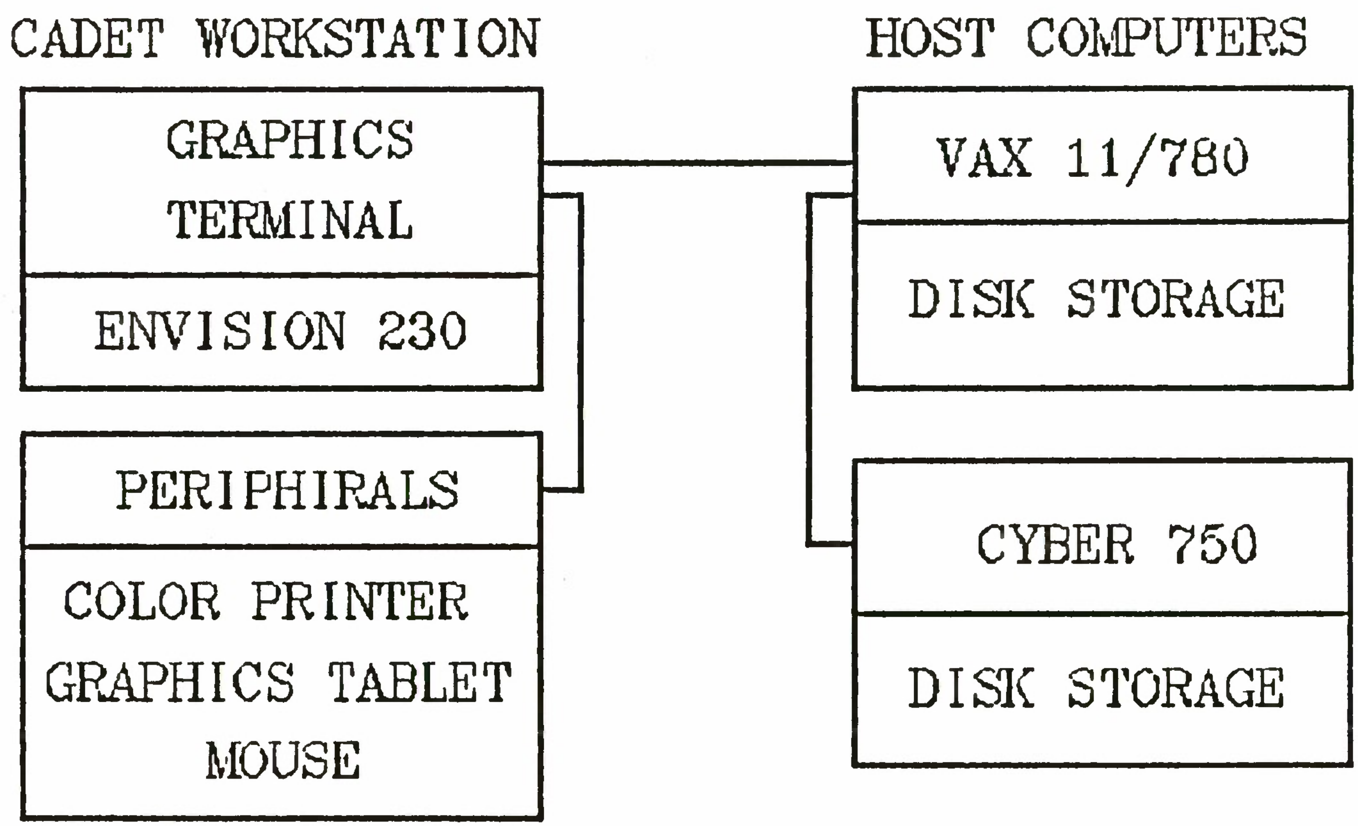
CADET

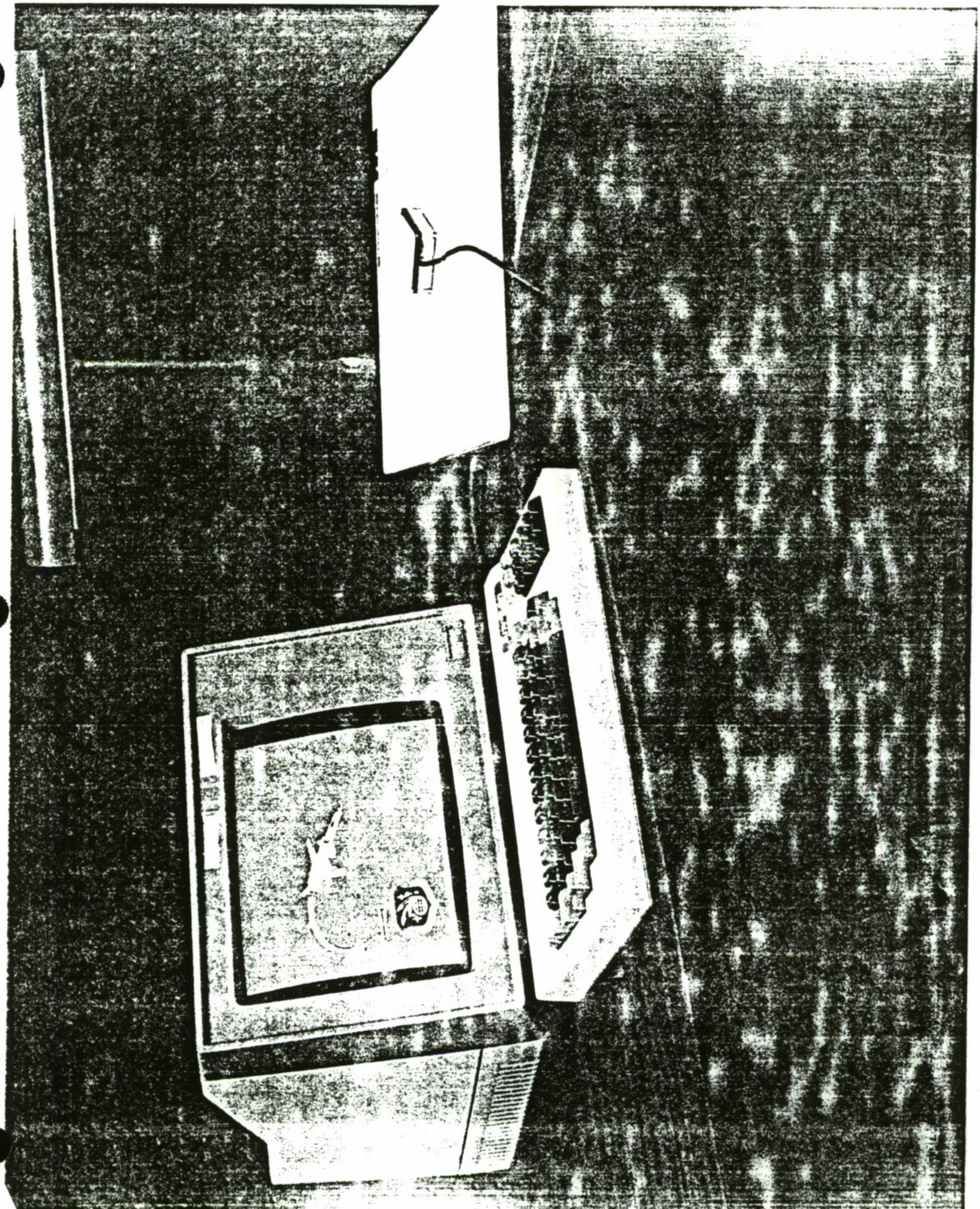
SYSTEM DESCRIPTION



CADET

SYSTEM HARDWARE





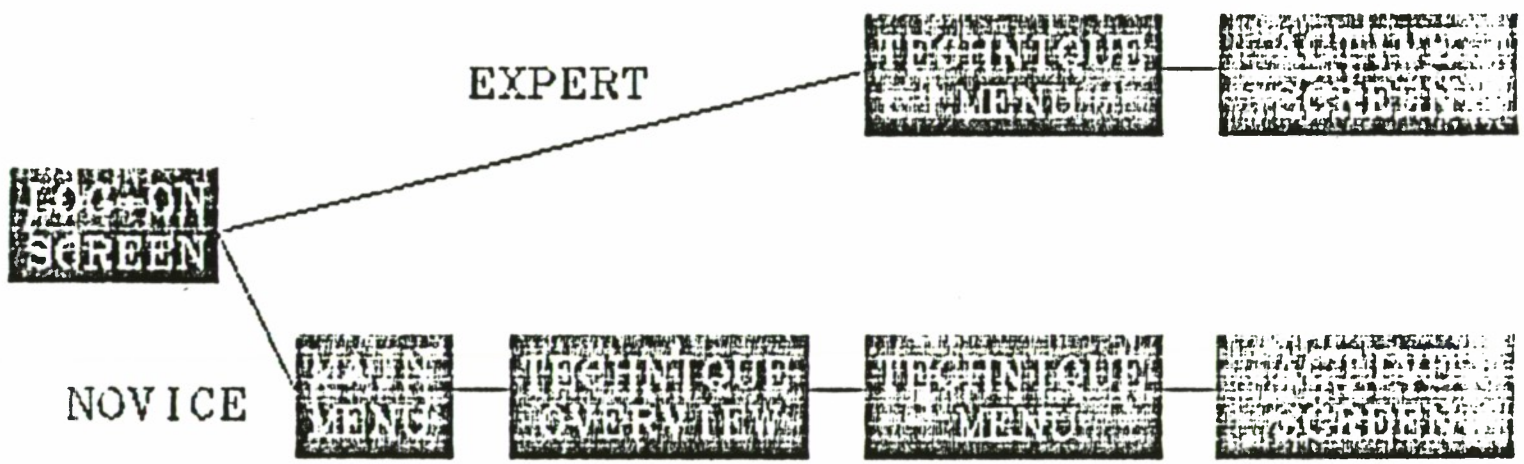
CADET

UIM OBJECTIVES

- STANDARDIZED TOOL INTERFACE
- EASY TO LEARN AND USE

CADET

UIM DESIGN



CADET

MAIN MENU

```
MAIN_CADET MENU:
          DISPLAY_FORMAT_DESIGN
          REACH_ASSESSMENT
          SYSTEM_ANALYSIS
          WORKLOAD_ASSESSMENT
          VAX_UTILITIES
          EXIT

SELECT AN OPTION BY TYPING THE FIRST WORD AND PRESSING RETURN

          TO GET BACK TO EXIT MENU SIMPLY PRESS RETURN

PLEASE SELECT AN OPTION: DISPLAY
```

CADET

TECHNIQUE MENU

DISPLAY_FORMAT_DESIGN MENU:

SAVE
RESTORE
DRAW
POLYGON
GRID
ENVISION_UTILITIES

SELECT AN OPTION BY TYPING THE FIRST WORD AND PRESSING RETURN

TO GET BACK TO MAIN_CADET MENU SIMPLY PRESS RETURN

PLEASE SELECT AN OPTION:

CADET

FUTURE DIRECTIONS

- 3-D GRAPHICS
- DATA BASE MANAGEMENT
- ADDITIONAL TOOLS
- MICROCOMPUTER-BASED CAD
- VOICE INTERACTIVE CAD

CADET

SUMMARY

- CAD TOOLS USEFUL
- CAD TOOLS PLENTIFUL
- CAD SYSTEM FEASIBLE
  - *USER FRIENDLY
  - *MODULAR STRUCTURE
  - *ALLOW FOR GROWTH

ATTACHMENT U

Maintenance Operation Data Access System

(MODAS) -- View Graphs

MAINTENANCE & OPERATIONAL DATA ACCESS SYSTEM

M O D A S

MR. CHUCK GROSS
AFLC/MME-2

BACKGROUND

JUL 58	TECHNICAL FAILURE REPORTING (AFTO FORM 26K)
DEC 60	PRODUCT PERFORMANCE SYSTEM (D056 - IBM 705)
62	D056 CONVERTED TO IBM 7080
64	CONTRACTORS PROVIDE RAW DATA
78	RELIABILITY AND MAINTAINABILITY REPORT
MAR 81	D056 CONVERTED TO CYBER
NOV 84	MODAS OPERATED BY AFLC

PURPOSE

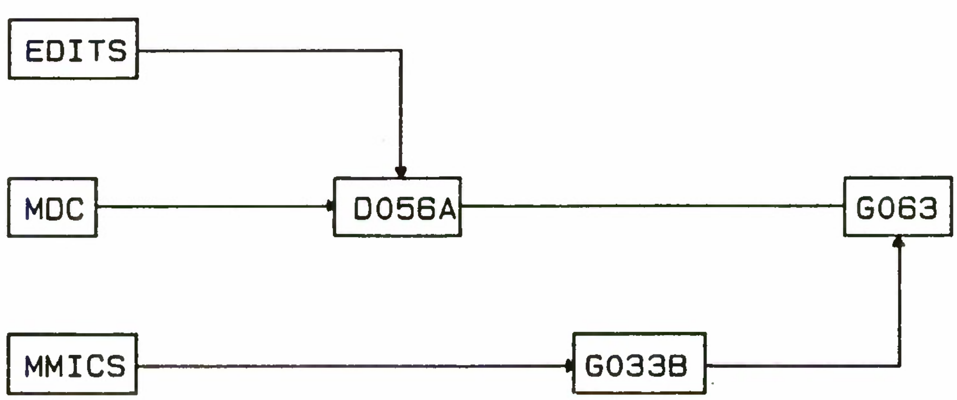
MANAGEMENT NEEDS

AUTOMATED ANALYSIS CAPABILITY

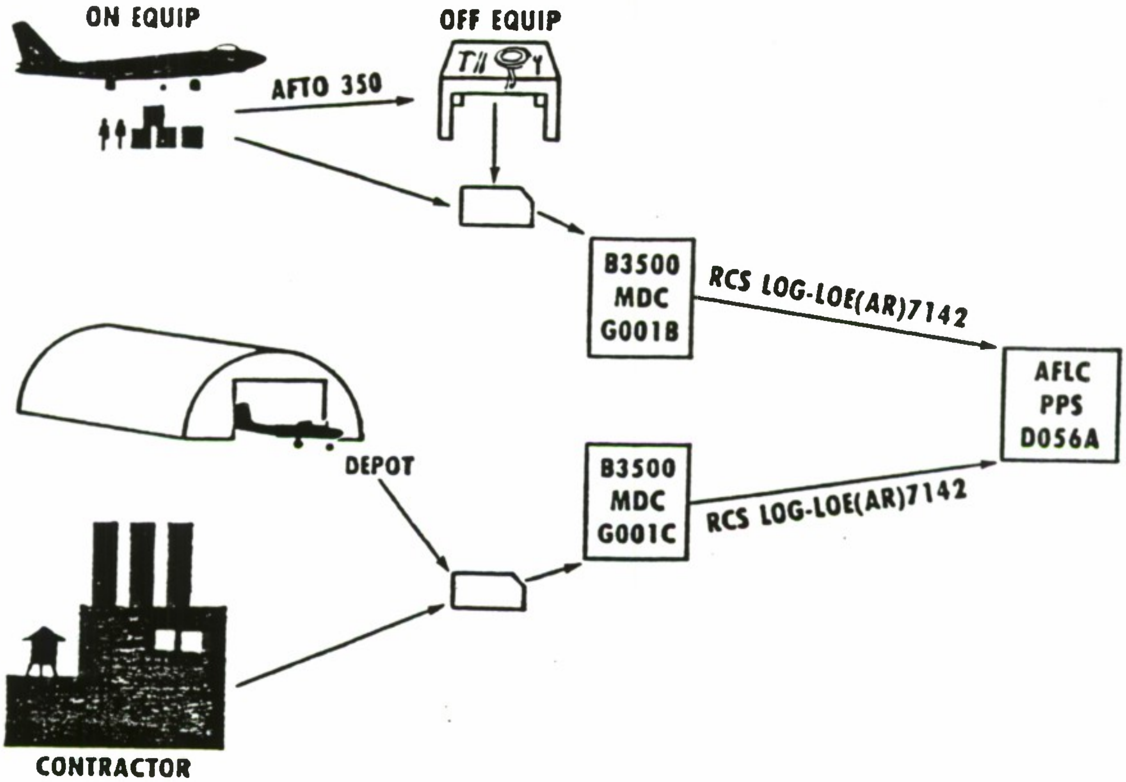
- RELIABILITY AND MAINTAINABILITY
- PRODUCT PERFORMANCE
- PRODUCT IMPROVEMENT

MODULARITY

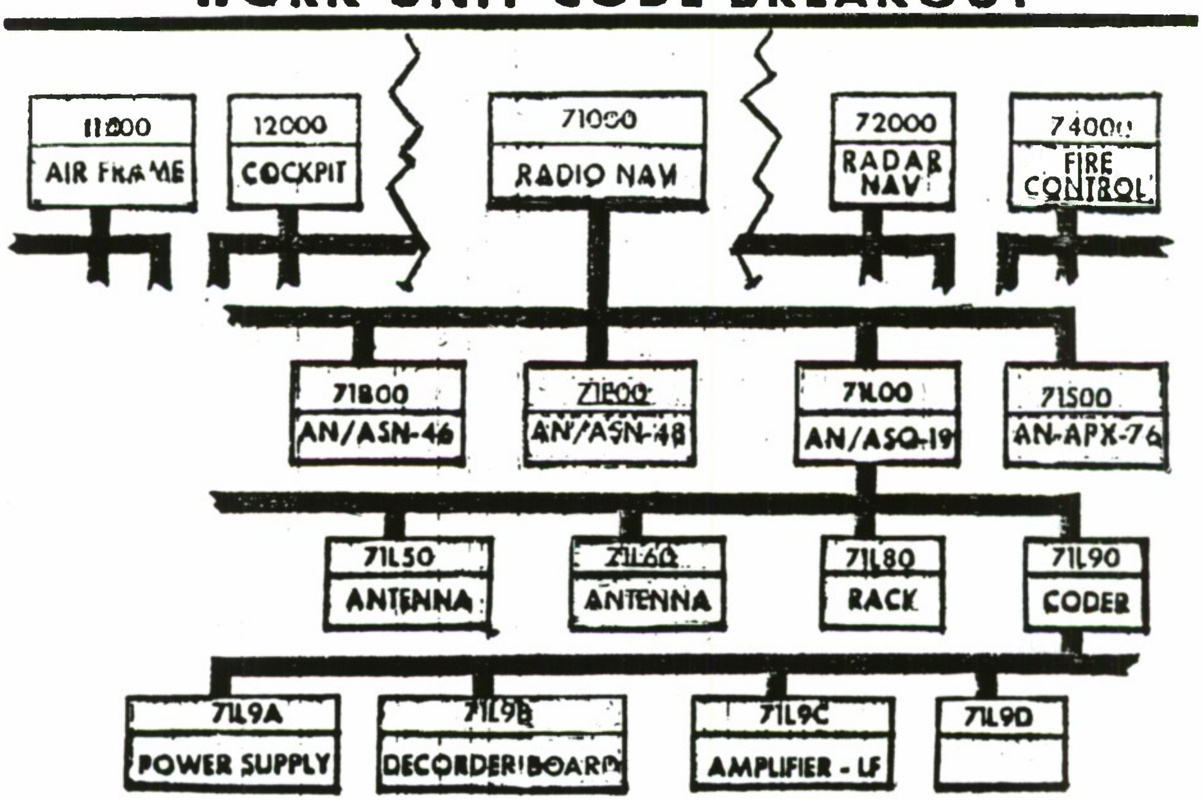
DESIGN



REPORTING FROM BASES, DEPOTS, AND CONTRACTORS



WORK UNIT CODE BREAKOUT



ORGANIZATION

MODAS

SYSTEM A		SYSTEM B
PRIME 750 8 600MB DISK COMM PACKAGE	⟷	PRIME 750 8 600MB DISK COMM PACKAGE

ACFT MANAGED BY OOALC	ACFT MANAGED BY WRALC
ACFT MANAGED BY SMALC	ACFT MANAGED BY SAALC
NON-AIRBORNE DATA	ACFT MANAGED BY OCALC

Prime 750 System 'A' Rev 19.2

HQ Air Force Logistics Command
Wright-Patterson AFB
Dayton, Ohio 45433

MAINTENANCE & OPERATIONAL DATA ACCESS SYSTEM (G063)

To report problems or to request assistance in using MODAS, please contact AFLC hot line at AV 787-5139 Mr. Chuck Gross where user problems will be logged in and resolved as quickly as possible. Problem log numbers will be assigned and it is important that subsequent communications refer to this log number.

Today is Tuesday, April 16, 1985
and the correct time is 7:28 AM EDT

ANY PROBLEMS CALL PRODUCTION STATUS AV 787-3251
COMMERCIAL 513 257-3251....

Key "RETURN" to continue:

```
DSD G083                                          Version 1.01

                    *** M O D A S ***
                 MARCON INDUSTRIES, INC.

          --------------- Main Menu ---------------

                 1. Airborne Data Menu

                 2. Non-Airborne Data Menu

                 3. Operational Data Menu

                 4. Tables / Library Menu

                99. Logout


ENTER YOUR SELECTION NUMBER (1-4 or 99) : 1
```

```
DSD G083                                          Version 1.01

                    *** M O D A S ***
                 MARCON INDUSTRIES, INC.

     --------------- Airborne Data Menu ---------------

     1. Worst Case - Reliability & Maintainability Report
     2. Summary Failure Data Search
     3. Reliability Status Report/Displays
     4. Maintainability Status Report/Displays
     5. Detail Maintenance Data Search
     6. Return To Main Menu

ENTER YOUR SELECTION NUMBER (1-6) : 1
```

ALC MENU

---

1 WARNER ROBINS
2 SAN ANTONIO
3 OKLAHOMA CITY
4 OGDEN
5 SACRAMENTO

SELECT NUMBER : 4

EAD MENU

1.	F004C	14.	NLF018A
2.	F004D	15.	NLF016B
3.	F004E	16.	NOF016A
4.	F004F	17.	NOF016B
5.	F004G	18.	GM025C
6.	F004T	19.	GM030B
7.	F016A	20.	GM065A
8.	F016B	21.	GM088A
9.	RF004C	22.	IR002A
10.	BEF018A	23.	BU015
11.	BEF016B	24.	S0212A
12.	OKF018A	25.	S0213B
13.	OKF016B		

SELECT NUMBER : 7

WORST CASE MENU

---

* Reliability *	* Maintainability *
1. Top 100 Wuc"s - by MTBM	5. Top 100 Wuc"s - by MH/FH
2. Top 100 Wuc"s - by Variance	6. Top 100 Wuc"s - by Variance
3. Top 50 Sub-Systems by MTBM	7. Top 50 Sub-Systems by MH/FH
4. All Systems - by MTBM	8. All Systems - by MH/FH

99. < END WORST CASE >

SELECT NUMBER : 1

Modas 16 APR 1985

F016A - Reliability Report #1
For Feb 85
* Top 100 Work Unit Codes *
Ranked by

Latest 3 Month MTBM (type 1 Failures)

Rank	Wuc	Noun	3 Month Failures	3 Month MTBM	Ranking Factor
1	65AD0	TRANSPONDER COMPUTER	268	145.42471	100.00
2	74DA0	INERTIAL NAVIG UNIT	255	151.69797	95.86
3	44AAE	LGHT WNGTIP NAV/FRM	223	173.46628	83.83
4	74AB0	RF UNIT LOW POWER	203	190.55655	78.32
5	23FBA	SEAL DIVRGNT NOZ SG	181	213.71814	68.05
6	63BA0	RCVR/XMITTER RADIO	180	214.90546	67.67
7	42GAA	BATTERY AIRCRAFT	171	228.21628	64.29
8	13DAB	TIRE MAIN LDG GEAR	169	228.89334	63.53
9	75CB0	LAUNCHER WING TIP	189	228.89334	63.53
10	13EAH	BRAKE ASSY	159	243.28915	59.77

DSD G063 Version 1.01

*** M O D A S ***
MARCON INDUSTRIES, INC.

--------------- Airborne Data Menu ---------------

1. Worst Case - Reliability & Maintainability Report
2. Summary Failure Data Search
3. Reliability Status Report/Displays
4. Maintainability Status Report/Displays
5. Detail Maintenance Data Search
8. Return To Main Menu

ENTER YOUR SELECTION NUMBER (1-8) : 2

SELECT WUC : 65AD0
SELECT BASE : ****

DSD G063 ***MODAS*** VERSION 1.01
SUMMARY FAILURE DATA LIST PAGE 1 OF 2 PAGES
PREPARED: 16 APR 1985

END ART DESIG: F016A BASE: **** = FLEET SUMMARY
WORK UNIT CODE: 65AD0 = TRANSPONDER COMPUTR

		MAINTAINANCE MANHOURS		EQUIP FAILURE COUNT			
DATE	FLIGHT HOURS	ON EQUIP	OFF EQUIP	TYPE1	TYPE2	TYPE6	1+2+6
83 3	9895.4	544.3	2.0	113	5	42	160
83 4	9581.8	590.4	24.0	125	7	60	192
83 5	10408.4	543.4	10.0	158	0	57	213
83 8	11203.3	375.3	6.0	117	2	13	132
83 7	10928.4	332.5	0.0	140	5	37	182
.	.	.	.	.	.	.	.
TOTAL	308335.5	9498.7	98.9	2728	93	924	3745

DSD G063 Version 1.01

*** M O D A S ***
MARCON INDUSTRIES, INC.

--------------- Airborne Data Menu ---------------

1. Worst Case - Reliability & Maintainability Report
2. Summary Failure Data Search
3. Reliability Status Report/Displays
4. Maintainability Status Report/Displays
5. Detail Maintenance Data Search
6. Return To Main Menu

ENTER YOUR SELECTION NUMBER (1-6) : 3

EAD MENU

1.	F004C	14.	NLF016A
2.	F004D	15.	NLF016B
3.	F004E	16.	NOF016A
4.	F004F	17.	NOF016B
5.	F004G	18.	GM025C
6.	F004T	19.	GM030B
7.	F016A	20.	GM065A
8.	F016B	21.	GM088A
9.	RF004C	22.	IR002A
10.	BEF016A	23.	BU015
11.	BEF016B	24.	S0212A
12.	DKF016A	25.	S0213B
13.	DKF016B		

SELECT NUMBER: 7

ENTER WUC: 65ADO
ENTER TYPE: 1
ENTER BASE: KRSM

PLOT MENU

1. CUMULATIVE MTBM PLOT
2. 3 MONTH MOVING AVG PLOT
3. MONTHLY MTBM PLOT
4. RELIABILITY STATUS REPORT
5. RE-ENTER WORK UNIT CODE & BASE

CURRENT SELECTION

AIRCRAFT: F016A
WUC: 65AD0 = TRANSPONDER COMPUTR
TYPE: 1
BASE: KRSM = HILL AFB, UTAH

SELECT NUMBER: 4

DSD G063 *** MODAS *** VERSION 1.01
RELIABILITY STATUS REPORT PAGE 1 OF 2 PAGES

PREPARED: 16 APR 1985

END ART DESIG: F016A BASE: KRSM - HILL AFB, UTAH
WORK UNIT CODE: 65AD0 - TRANSPONDER COMPUTR
TYPE FAILURE: 1

	FLIGHT HOURS		TOTAL FAILURE	MEAN TIME BETWEEN MAINTENANCE		
DATE	ACTUAL	CUM.	COUNT	MONTHLY	3 MONTH	CUM.
83 3	2103.8	2103.8	37	58.85	0.00	58.85
83 4	2282.3	4385.9	49	48.17	0.00	50.77
83 5	2287.0	6652.9	57	40.12	48.52	46.52
.	.	.	.	.	.	.
TOTAL	68331.8		872			

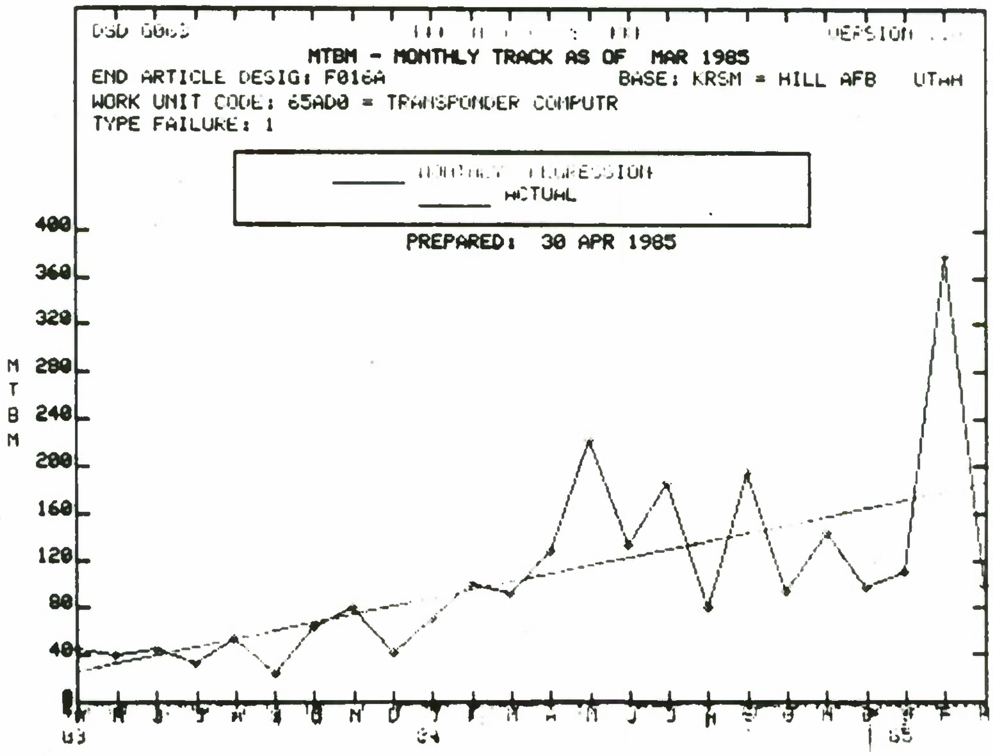
PLOT MENU

1. CUMULATIVE MTBM PLOT
2. 3 MONTH MOVING AVG PLOT
3. MONTHLY MTBM PLOT
4. RELIABILITY STATUS REPORT
5. RE-ENTER WORK UNIT CODE & BASE

CURRENT SELECTION

AIRCRAFT: F016A
WUC: 65AD0 = TRANSPONDER COMPUTR
TYPE: 1
BASE: KRSM = HILL AFB, UTAH

SELECT NUMBER: 3



DSD G063 Version 1.01

*** M O D A S ***
MARCON INDUSTRIES, INC.

--------------- Airborne Data Menu ---------------

1. Worst Case - Reliability & Maintainability Report
2. Summary Failure Data Search
3. Reliability Status Report/Displays
4. Maintainability Status Report/Displays
5. Detail Maintenance Data Search
6. Return To Main Menu

ENTER YOUR SELECTION NUMBER (1-6) : 4

PLOT MENU

1. CUMULATIVE MH/FH PLOT
2. 3 MONTH MOVING AVG PLOT
3. MONTHLY MH/FH PLOT
4. MAINTAINABILITY STATUS REPORT
5. RE-ENTER WORK UNIT CODE & BASE

CURRENT SELECTION

AIRCRAFT: F016A
WUC: 65AD0 = TRANSPONDER COMPUTR
BASE: KRSM = HILL AFB, UTAH

SELECT NUMBER: 4

```
OSD G063                      *** MODAS ***                  VERSION 1.01
MAINTAINABILITY STATUS REPORT                            PAGE 1 OF 2 PAGES

                                                    PREPARED: 16 APR 1985

END ART DESIG: F016A                        BASE: KRSM - HILL AFB, UTAH
WORK UNIT CODE: 65AD0 - TRANSPONDER COMPUTR
```

	FLIGHT HOURS		MAINTENANCE MH			MH/FH		
			--ON-	----OFF--				
DATE	ACTUAL	CUM.	EQUIP	EQUIP	TOTAL	MTHLY	3 MTH	CUM.
83 3	2103.6	2103.6	76.3	0.0	76.3	0.0363	0.0000	0.0363
83 4	2282.3	4385.9	88.6	0.0	88.8	0.0392	0.0000	0.0378
83 5	2267.0	6652.9	67.2	0.0	67.2	0.0294	0.0349	0.0349
.	.	.	.	.	.	.	.	.
TOTAL	66331.8		1581.4	0.0	1581.4			

```
OSD G063                                                    Version 1.01

                            *** M O D A S ***
                           MARCON INDUSTRIES, INC.

                --------------- Airborne Data Menu ---------------

                  1. Worst Case - Reliability & Maintainability Report
                  2. Summary Failure Data Search
                  3. Reliability Status Report/Displays
                  4. Maintainability Status Report/Displays
                  5. Detail Maintenance Data Search
                  6. Return To Main Menu

ENTER YOUR SELECTION NUMBER (1-6) : 5
```

RECORD TYPE MENU

1. "A" ON EQUIPMENT AIRCRAFT
2. "EF" ON EQUIPMENT ENGINE
3. "G" ON EQUIPMENT NON-AIRBORNE
4. "H" OFF EQUIPMENT
5. "P" PARTS REPLACED DURING REPAIR
6. "R" R&R OF SERIALIZED COMPONENTS
7. "S" SUMMARIZED AIRCRAFT SUPPORT GENERAL
8. "T" R&R OF AIRCRAFT ENGINE

SELECT NUMBER: 1

* SELECT MONTH(S) OR ALL *

1. LATEST 30 DAYS (FEB 85)
2. LATEST 60 DAYS (JAN 85-FEB 85)
3. LATEST 90 DAYS (DEC 84-FEB 85)
4. LATEST 12 MONTHS (MAR 84-FEB 85)
5. LATEST 24 MONTHS (MAR 83-FEB 85)
6. SPECIAL SELECTION MENU

SELECTION NUMBER: 3

```
EAD : F016A        DETAIL MAINTENANCE DATA REPORT      APR 16 1985

                          SEARCH INDEX MENU
                  ----------------------------------

1.  AIRCRAFT                     14.  TYPE HOW MAL
2.  SERIAL NO.                   15.  EAD OR MDS
3.  WORK CENTER                  16.  TIME
4.  TYPE MAINT.                  17.  YEAR
5.  SRD                          18.  DAY
6.  WUC                          19.  CPN
7.  ACTION TAKEN                 20.  UNITS
8.  WHEN DISCOV                  21.  START TIME
9.  HOW MAL                      22.  STOP TIME
10. BASE                         23.  CREW
11. COMMAND                      24.  TAG NO.
12. JCN                          25.  JCN2  (PART2)
13. LAST 4 OF ID
----------------------------------------------------------------------

    SELECT NUMBER:   6
ENTER STRING:   65AD0
ENTER STRING:
    SELECT NUMBER:   10
ENTER STRING:   KRSM
ENTER STRING:
    SELECT NUMBER:

ARE SEARCH SELECTIONS SATISFACTORY < Y OR N > :   Y
```

```
       *  SEARCH BEGINNING......     WORKING

     DEC 84      35  RECORDS
     JAN 85      28  RECORDS
     FEB 85       9  RECORDS

                 72  TOTAL RECORDS


                    OUTPUT MENU
              ----------------------

  1.   DISPLAY DATA
  2.   REPORT GENERATOR
  3.   RESELECT OTHER SEARCH CRITERIA
  4.   < EXIT >   ( END MAINTENANCE SEARCH )

SELECT NUMBER :   1
```

DISPLAY FIELDS AVAILABLE

1.	AIRCRAFT	14.	TYPE HOW MAL
2.	SERIAL NO.	15.	EAD OR MDS
3.	WORK CENTER	16.	TIME
4.	TYPE MAINT.	17.	YEAR
5.	SRD	18.	DAY
6.	WUC	19.	CPN
7.	ACTION TAKEN	20.	UNITS
8.	WHEN DISCOV	21.	START TIME
9.	HOW MAL	22.	STOP TIME
10.	BASE	23.	CREW
11.	COMMAND	24.	TAG NO.
12.	JCN	25.	JCN2 (PART2)
13.	LAST 4 OF ID		

SELECT NUMBER: 1
SELECT NUMBER: 2
SELECT NUMBER: 4
SELECT NUMBER: 6
" " "
SELECT NUMBER:

WRITE TO SCREEN, PRINTER, OR RESELECT < S, P, R > : P

DSDG063 *** MODAS *** PAGE 1
EAD : F016A DETAIL MAINTENANCE DATA REPORT APR 16 1985

AIRCRAFT	SERIAL NO	TYPE MAINT	WUC	ACTION TAKEN	WH
F016A	81000124	B	51000	Y	D
F016A	81000152	B	51000	L	D
F016A	81000152	B	51000	Y	D
F016A	81000154	B	51000	L	D
F016A	81000168	B	51000	P	F
F016A	81000168	B	51000	Q	D
"	"	"	"	"	"

RECORD TYPE MENU

1	" A "	ON EQUIPMENT AIRCRAFT
2	" EF"	ON EQUIPMENT ENGINE
3	" G "	ON EQUIPMENT NON-AIRBORNE
4	" H "	OFF EQUIPMENT
5	" P "	PARTS REPLACED DURING REPAIR
6	" R "	R & R OF SERIALIZED COMPONENTS
7	" S "	SUMMARIZED AIRCRAFT SUPPORT GENERAL
8	" T "	R & R OF AIRCRAFT ENGINE

SELECT NUMBER: 4

EAD MENU

---

1. C005A	11. T037
2. C009A	12. T038
3. C009C	13. T038B
4. C131	14. T041A
5. F005	15. T043A
6. F005E	16. T046A
7. F005F	17. OA037B
8. F099A	18. OV010
9. F106A	19. QF102
10. 0002	

SELECT NUMBER: 12

```
EAD: T038          DETAIL MAINTENANCE DATA REPORT          MAY 08 1985

                          SEARCH INDEX MENU
          ______________________________________________


      1.  FSC                      14.  TYPE HOW MAL
      2.  COMP PN                  15.  EAD OR MDS
      3.  WORK CENTR               16.  TIME
      4.  TYPE MAINT               17.  YEAR
      5.  SRD                      18.  DAY
      6.  WUC                      19.  CPN
      7.  ACTION TAKEN             20.  UNITS
      8.  WHEN DISCOV              21.  START TIME
      9.  HOW MAL                  22.  STOP TIME
     10.  BASE                     23.  CREW
     11.  COMMAND                  24.  TAG NO.
     12.  JCN                      25.  JCN2   (PART 2)
     13.  LAST 4 OF ID


      SELECT NUMBER:
```

```
DSD G083                                          Version 1.01

                    *** M O D A S ***
               MARCON INDUSTRIES,  INC.


           --------------Main Menu--------------

                 1. Airborne Data Menu

                 2. Non-Airborne Data Menu

                 3. Operational Data Menu

                 4. Tables / Library Menu

                99. Logout

   ENTER YOUR SELECTION NUMBER (1-4 OR 99) :  3
```

DSD G083 Version 1.01

*** M O D A S ***

MARCON INDUSTRIES, INC.

----------Operational Data Menu----------

1. Operational Status Report/Displays
2. Detail Operational Data Search
3. Return To Main Menu

ENTER YOUR SELECTION NUMBER (1-3) : 1

MDS Menu

----

1. F004C	11. BEF016B	21. LGM030G
2. F004D	12. DKF016A	22. AGM065A
3. F004E	13. DKF016B	23. AGM065B
4. F004F	14. NLF016A	24. AGM065C
5. F004G	15. NFL016B	25. AGM065E
6. F004T	16. NOF016A	26. AGM088A
7. F016A	17. NOF016B	27. AIR002A
8. F016B	18. LGM025C	28. GBU015
9. RF004C	19. LGM030B	29. WS212A
10. BEF016A	20. LGM030F	30. WS213B

SELECT NUMBER : 7

ENTER COMMAND (TAC, SAC, ETC.... OR, ***, FOR ALL) : TAC

ENTER BASE CODE (KRSM, NVZR, ETC... OR, ****, FOR, ALL): KRSM

ARE SEARCH SELECTIONS SATISFACTORY < Y OR N > : Y

* SEARCH BEGINNING..... WORKING

Version 1.01

*** M O D A S ***

DSD G063
OPERATIONAL STATUS REPORT

PAGE 1 OF 2 PAGES
PREPARED 16 APR 1985L1300
BASE: KRSM - HILL AFB UTAH

MDS: F016A
COMMAND: TAC

DATE	TOTAL FLIGHT HOURS	SORTIES	AVERAGE AIRCRAFT INVENTORY	TOTAL POSSESSED HOURS	FULLY MISSION CAPABLE	NOT MISSION CAPABLE	PARTLY MISSION CAPABLE
8303	2093.1	1507	73	54127	33305	19040	1782
8304	2254.5	1848	74	53073	35122	16849	1102
8305	2284.0	1678	80	58508	41578	17771	161
8308	2188.3	1747	81	58158	50097	12651	277
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
8502	2285.8	1784	101	87832	81137	6695	0
	81535.5	44515	2132	1557041	1311175	238882	7004

```
DSD G083                                              Version 1.01

                     *** M O D A S ***
                  MARCON INDUSTRIES, INC.


           ----------Operational Data Menu----------

            1. Operational Status Report/Displays

            2. Detail Operational Data Search

            3. Return To Main Menu

     ENTER YOUR SELECTION NUMBER (1-3) :  2
```

```
EAD : G033B                                           APR 16 1985

              Detail Operational Data Report

                     Search Index Menu
     -------------------------------------------------------

      1. SUB COMMAND                13. NMCM/UNSCH
      2. CLASS MISSION              14. NMCM/SCH
      3. MOD MISSION                15. NMCS
      4. MDS                        16. PMCB
      5. MONTH CODE                 17. PMCM
      6. COMMAND                    18. PMCS
      7. STATION                    19. FLYING HRS
      8. YEAR                       20. SORTIES
      9. LEAD THE FORCE             21. LANDINGS
     10. POSSESSED HRS              22. AS OF ORDINAL DATE
     11. NCMB/UNSCH                 23. AVG INVENTORY
     12. NMCB/SCH

             SELECT NUMBER :  4
         ENTER STRING :  F016A
         ENTER STRING :
             SELECT NUMBER :  7
         ENTER STRING :  KRSM
         ENTER STRING :
             SELECT NUMBER :
```

PLOT MENU

1. FLIGHT HOURS BY MONTH
2. SORTIES BY MONTH
3. FULLY MISSION CAPABLE BY MONTH
4. NOT MISSION CAPABLE BY MONTH
5. PARTLY MISSION CAPABLE BY MONTH
6. OPERATIONAL STATUS REPORT
7. RE-SELECT COMMAND, BASE

CURRENT SELECTION

AIRCRAFT: F016A
COMMAND: TAC
BASE: KRSM = HILL AFB UTAH

SELECT NUMBER : 6

DSD G083 Version 1.01

*** M O D A S ***
MARCON INDUSTRIES, INC.

--------------Main Menu--------------

1. Airborne Data Menu
2. Non-Airborne Data Menu
3. Operational Data Menu
4. Tables / Library Menu

99. Logout

ENTER YOUR SELECTION NUMBER (1-4 OR 99) : 4

DSD G083 Version 1.01

*** M O D A S ***

MARCON INDUSTRIES, INC.

---------Tables/Library Menu---------

1. Work Unit Codes (B4 - Master)

2. Constant Tables (A1 - B3)

3. Return To Main Menu

ENTER YOUR SELECTION NUMBER (1-3) : 1

DSD G083 Version 1.01

*** M O D A S ***

B4 - MASTER DATA LIST PREPARED 16 APR 1985

END ART DESIG: F016A

WORK UNIT CODE: 65***

```
--------------------------------------------------------------------------
LI 100
B4  AE   F016A650001FF SYSTEM      B000000100000   0000000100  7902 A
B4  AE   F016A65A00AIR/GROUND IFF  B000000100000   0000000100  7902 A
B4  AE   F016A65A99NOC             C000009900000   0000000100  7902 A
B4  AE   F016A65AAFBIT RF          B000000100000   0000000100  7902 A
 .   .        .                          .               .        .  .
 .   .        .                          .               .        .  .
 .   .        .                          .               .        .  .
B4  AE   F016A65AARCCA MODE 4      B000000100000   0000000100  7902 A
```

TABLES MENU

----

1. A1 - Action Taken Codes
2. A2 - When Discovered Codes
3. A3 - How Malfunctioned Codes
4. A4 - Base (Station) Codes
5. A5 - Federal Supply Class
6. A6 - SRD/MDS Cross Reference
7. A7 - Commands
8. A8 - Type Maintenance
9. A9 - EAD
10. B3 - EAD/MDS Cross Reference

SELECT NUMBER: 4

DSD G063 Version 1.01

*** M O D A S ***
MARCON INDUSTRIES, INC.

---------Tables/Library Menu---------

1. Work Unit Codes (B4 - Master)

2. Constant Tables (A1 - B3)

3. Return To Main Menu

ENTER YOUR SELECTION NUMBER (1-3) : 2

DSD G083 Version 1.01

*** M O D A S ***
MARCON INDUSTRIES, INC.

-------------Main Menu-------------

1. Airborne Data Menu

2. Non-Airborne Data Menu

3. Operational Data Menu

4. Tables / Library Menu

99. Logout

ENTER YOUR SELECTION NUMBER (1-4 OR 99) : 99

MAINTENANCE DATA COLLECTION SYSTEM (MDC)

* DETERMINE ON/OFF

* USES CODE

  WORK UNIT CODE (WUC)
  HOW MAL
  ACTION TAKEN
  TYPE MAINTENANCE
  BASE
  COMMAND
  WORK CENTERS

SOME HFE USES OF MDC

MANHOURS USED

CLOCKHOURS USED

FAILURE RATES (LRU)

SEQUENCE OF ACTIONS

WORK CENTER ACTIVITY

SUMMARY

MAINTENANCE AND OPERATIONAL DATA
ACCESS SYSTEM

(MODAS)

* RELIABILITY DATA
* MAINTAINABILITY DATA
* ON LINE
    ** TREND PLOTS
    ** DETAILED REPORTS
    ** USER DESIGNED REPORTS

LEVELS OF MDC

- BASE LEVEL
  - MAINTENANCE DATA COLLECTION SYSTEM (MDC)
  - MAINTENANCE MANAGEMENT INFORMATION & CONTROL SYSTEM (MMICS)
    - -- BASE LEVEL INQUIRY SYSTEM (BLIS)
    - -- AIR FORCE ON LINE DATA SYSTEM (AFOLDS)
  - CORE AUTOMATED MAINTENANCE SYSTEM (CAMS)
    - -- DEPLOYABLE CORE AUTOMATED MAINTENANCE SYSTEM (DCAMS)
- ACQUISTION & LOGISTICS LEVEL
  - PRODUCT PERFORMANCE SYSTEM (D056)
  - SYSTEMS EFFECTIVENESS DATA SYSTEM (SEDS)
  - MAINTENANCE & OPERATIONAL DATA ACCESS SYSTEM (MODAS)

Glossary of Terms

Computed Average Inventory. Computed by dividing the total hours that a fleet (EAD) was possessed by a command at a base, by the total hours that a vehicle could have been possessed in a given month.

Fleet Operating Time. Represents an accumulation of fleet hours or assumed operating hours.

Fleet Inventory. The end article inventory.

Indirect Labor. Productive indirect hours expended for leave, details, compensatory time-off, training, and alert duty.

Mean Sorties Between Failure (MSBF). Calculated by dividing number of failures by number of sorties.

Mean Time Between Maintenance, Type-1 (MTBM-1). Calculated by dividing operating time (adjusted by QPA and Use factor) by the number of failures. When special inventory is available, the result is multiplied by the inventory ratio.

Mean Time Between Maintenance, Type-T (MTBM-T). Calculated by dividing Operating Time (adjusted by QPA and Use Factor) by units completed on selected maintenance actions.

OFF-Equipment. Assemblies, subassemblies, or components apart from an end item of equipment.

ON-Equipment. On Equipment is considered to be end articles of equipment during the maintenance process and is defined as aircraft, drones, trainers, missiles, registered SE, photographic equipment, ground C-E equipment, special weapons, aircraft engines, and L systems. Although they are considered to be components while installed in the major component, aircraft engines and turbine engines for SE will be considered as end items articles during in-shop work.

ON Equipment Work. This includes support general work (accomplishment of scheduled and special inspections), removal and replacement of components, and fix-in-place repair actions. Repairs accomplished in the vicinity of the end article on components removed for the convenience of making repairs or requirements for installation preparation are also considered to be on-equipment work. Removal and replacement of complete engines in aircraft, air launched missiles, and SE are considered to be on-equipment work with the engine considered as component. After removal and during in-shop work, aircraft engines and SE gas turbine engines are considered to be end articles and the on-equipment/off-equipment concepts apply.

Sorties/Landings. Total landings and sorties launched as reported in accordance with AFR 65-110 during the requested time frame. Applicable only to aircraft and aircraft engines.

Special Inventory. Inventory established in the B4 Master File. Specifies the inventory of the WUC when only a number of the end items (not the entire fleet) has the WUC item installed, or when the inventory is not available from the AFR 65-110 data. For those, EADs (Not 65-110 reportable) the first inventory for a WUC will represent inventory for the EAD.

Terms and Abbreviations

Abbreviations	Description
ACF	Aircraft, Drones, and Related Trainers
ALM	Air Launched Missiles and Peculiar SE
ATC	Action Taken Code
C-E	Communications-Electronic Equipment
CPN	Component Position Number
EAD	End Article Designator
ENG	Aircraft Engines
GLM	Ground Launched Missiles and Peculiar SE
HMC	How Malfunction Code
JCN	Job Control Number
JEIM	Jet Engine Intermediate Maintenance
MDS	Mission Design Series (Aircraft)
SE	Support Equipment
SRD	Standard Reporting Designator
SRU	Shop Replaceable Unit (Identified by a 5 position Work Unit Code)
TCTO	Time Compliance Technical Order
TMC	Type Maintenance Code
TMS	Type Model Series (Engine)
TRS	Mobile Training Sets and Simulators
WDC	When Discovered Code
WEP	Munitions
WUC	Work Unit Code

ALL DATA CODES USED IN THE AIR FORCE ARE LISTED IN AFM 300-4, VOL III,AIR FORCE DATA DICTIONARY. THERE IS ABOUT 20 MICROFICHE SHEETS LISTING THE CODES USED ANY WHERE IN THE AIR FORCE.

FOR EXAMPLE:

ACTION TAKEN	ADE AC-780
WHEN DISCOVERED	ADE WH-165
HOW MALFUNCTION	ADE HO-920
BASE (LOCATION)	ADE GE-611
COMMAND	ADC MA-360
TYPE MAINTENANCE	ADE MA-358

MAINTENANCE DATA COLLECTION RECORD

OMB NO 21-R0227

1. JOB CONTROL NO.	2. WORKCENTER	3. I.D. NO./SERIAL NO.	4. MDS	5. SRD	6. TIME	7. PRI	8. SORTIE NO.	9. LOCATION

10. ENG. TIME	11. ENGINE I.D.	12. INST ENG TIME	13. INST. ENG. I.D.	14.	15.	16.	17. TIME SPC OFG	18. JOB STD.

19. FSC	20. PART NUMBER	21. SER. NO./OPER. TIME	22. TAG NO.	23. INST. ITEM PART NO.	24. SERIAL NUMBER	25. OPER. TIME

ACT. LINE	A TYPE MAINT	B COMP POS	C WORK UNIT CODE	D ACTION TAKEN	E WHEN DISC	F HOW MAL	G UNITS	H START HOUR	I STOP DAY	I STOP HOUR	J CREW SIZE	K CAT LAB	L CMD ACT ID	M SCH CODE	N AFSC/EMPLOYEE NUMBER
1															
2															
3															
4															
5															

26. DISCREPANCY

27. CORRECTIVE ACTION

28. RECORDS ACTION

AFTO FORM JAN 81 349 PREVIOUS EDITION WILL BE USED.

29. PARTS REPLACED DURING REPAIR (SUBASSEMBLIES REPAIRED/REPLACED)

LINE NO	A FSC	B PART NUMBER	C WORK UNIT CODE	D REF SYMBOL	E HOW MAL	F QTY

30. CONTINUATION FROM BLOCK ....

BUCHER BROS. 6-68 15,000

WARNING

Unauthorized persons removing, defacing, or destroying this tag (or label) may be subject to a fine of not more than $1,000 or imprisonment for not more than one year or both. (18 USC 1 36 1)

REPAIR CYCLE DATA

23. FSN	24. SRAN CODE
25. TRANSPORTATION CONTROL NUMBER	

DATE	STATUS CHANGED TO
26. REMOVED	34. SERVICEABLE
27. REC'D. IN BASE SUPPLY	
28. SHIPPED TO TMO	
29. REC'D. AT SRA	35. CONDEMNED
30. ORDERED BY MAINT.	
31. REC'D. IN MAINT. SHOP	
32. MADE SERVICEABLE	
33. FOR DEPOT USE ONLY	36. SUPPLY INSPECTOR'S STAMP

37. BASE REPAIR CYCLE DATA		DAY	MO.	YR.	TIME
DATE REMOVED	REC'D BY RPC				AWM
TO:					
TO:					AWP
TO:					
TO:					
TO:					
DATE COMPLETED					

AFTO FORM 350 JAN. 68

REPARABLE ITEM PROCESSING TAG

1. JOB CONTROL NO.	2. ID / SERIAL NO.	3. WO. NO. PRE-SUFFIX	4. WHEN DISC.

5. HOW MAL	6. MDS	7. WORK UNIT CODE	8. ITEM OPER. TIME	9. QTY

10. FSC	11. PART NUMBER
12. SERIAL NUMBER	13. SUPPLY DOCUMENT NUMBER

14. DISCREPANCY

15. SHOP USE ONLY

TAG NO. 0050809 AFTO 350 PT. I

16. SUPPLY DOCUMENT NUMBER

17. NOMENCLATURE

18. PART NUMBER

19. FSN

20. ACTION TAKEN	21. QTY	22. RPC USE ONLY

TAG NO. 0050809 AFTO 350 PT II

DATA ELEMENTS UTILIZED IN THE MAINTENANCE DATA COLLECTION SYSTEM
SOURCE: AFR 66-1, AFR 66-267, AND 00-20 SERIES TECHNICAL ORDERS.

JOB CONTROL NUMBER (JCN) - A UNIQUE SEVEN CHARACTER NUMBER USED TO CONTROL AND IDENTIFY MAINTENANCE JOBS, AS WELL AS TO IMPROVE ANALYSIS CAPABILITY. EXAMPLE: 0410001 ;041 IS THE JULIAN DATE AND 0001 IS THE FIRST JOB OF THE DAY.

PERFORMING WORKCENTER CODE (PWC) - A SPECIFIED FIVE CHARACTER CODE USED TO IDENTIFY THE WORKCENTER ACCOMPLISHING THE MAINTENANCE ACTION.
EXAMPLE: U4500 ; THE FIRST POSITION IDENTIFIES DIVISIONS, WINGS, SEPARATE SQUADRONS, OR COMMANDS LOCATED ON A BASE. THE SECOND POSITION SIGNIFIES THE VARIOUS FUNCTIONS WITHIN THE MAINTENANCE COMPLEX. THE THIRD POSITION IN MOST CASES IS THE SUBFUNCTION WITHIN A SQUADRON. THE FORTH AND FIFTH POSITION IDENTIFIES A SPECIFIC BRANCH, SHOP OR SITE. THE ASSIGNMENT OF THE SECOND POSITION IS REQUIRED TO INSURE COMPUTER EDITS ARE CORRECT. THE ASSIGNED SECOND POSITION WORKCENTER CODES ARE:

(1) 1 - CHIEF OF MAINTENANCE
(2) 2 - ORGANIZATIONAL MAINTENANCE
(3) 3 - FIELD MAINTENANCE
(4) 4 - AVIONICS AND AIRBORNE MISSILE MAINTENANCE
(5) 5 - MUNITIONS MAINTENANCE
(6) 6 - GROUND COMMUNICATIONS - ELECTRONICS MAINTENANCE
(7) 7 - NOT ASSIGNED
(8) 8 - GROUND LAUNCHED MISSILE MAINTENANCE
(9) 9 - NONREPORTING WORKCENTERS
(10) 0 - AWAY FROM HOME STATION MAINTENANCE
(11) P - GROUND PHOTOGRAPHIC EQUIPMENT MAINTENANCE
(12) M - CIVIL ENGINEERING/ICBM MAINTENANCE
(13) S - GROUND LAUNCHED MISSILE NONREPORTING WORKCENTERS
(14) G - FIRST ACFT GENERATION SQUADRON
(15) H - SECOND ACFT GENERATION SQUADRON
(16) E - EQUIPMENT MAINTENANCE SQUADRON
(17) R - COMPONENT REPAIR SQUADRON
(18) ALL REMAINING A - Z IS AUTHORIZED DEPOT MAINTENANCE

IDENTIFICATION NUMBER (ID)- CONSISTS OF SIX CHARACTERS, AND IS USED TO IDENTIFY EQUIPMENT ON WHICH WORK WAS PERFORMED OR FROM WHICH AN ITEM WAS REMOVED. THE FIRST POSITION DESIGNATES WHO OWNS THE EQUIPMENT. THE SECOND POSITION IS THE FISRT CHARACTER OF THE STANDARD REPORTING DESIGNATOR CODE. THE LAST FOUR POSITIONS ARE NORMALLY THE LAST FOUR CHARACTERS OF THE EQUIPMENT SERIAL NUMBER.

STANDARD REPORTING DESIGNATOR (SRD)- CONSISTS OF THREE CHARACTERS AND ARE ASSIGNED TO IDENTIFY A SPECIFIC TYPE OR CATEGORY OF EQUIPMENT. THE FIRST POSITION OF THE SRD CODE IDENTIFIES THE GENERAL TYPE OF EQUIPMENT AS LISTED BELOW.

A - AIRCRAFT AND DRONES
B - GROUND RADIO EQUIPMENT
C - " " "
E - " " "
F - GROUND METEROLOGICAL EQUIPMENT
G - SUPPORT EQUIPMENT
H - PRECISION MEASUREMENT EQUIPMENT
J - GROUND SPECIAL ELECTRONICS
K - GROUND FIXED WIRE EQUIPMENT
L - MISCELLANEOUS GROUND COMMUNICATION EQUIPMENT

M - GROUND LAUNCHED MISSILES
N - AIR LAUNCHED MISSILES AND GUIDED WEAPONS
Q - ELECTRONICS SECURITY COMMAND MISSION EQUIPMENT
R - REAL PROPERTY INSTALLED EQUIPMENT, SHOP WORK, ECM PODS/VEHICLES, GEARBOXES AND MODULES, SPECIAL PURPOSE PODS.
S - AGE GAS TURBINES, AUXILIARY POWER UNITS.
T - TRAINERS, MOBILE TRAINING SETS, AND RESIDENT TRAINING EQUIPMENT
U - COMMUNICATIONS SECURITY EQUIPMENT
X - ENGINES
Y - MUNITIONS
Z - MISCELLANEOUS LOCAL SUPPLIES
1 THROUGH 8 ARE NORAD COMBAT OPERATIONS CENTERS

TYPE MAINTENANCE CODES (TM) - A CHARACTER USED TO IDENTIFY THE TYPE OF WORK ACCOMPLISHED. TYPE MAINTENANCE CODES ARE OBTAINED FROM THE APPLICABLE WORK UNIT CODE MANUALS FOR THE TYPE OF EQUIPMENT WORK IS BEING PERFORMED ON. AIRCRAFT TYPE MAINTENANCE CODES ARE LISTED BELOW.

A - SERVICING
B - UNSCHEDULED MAINTENANCE
C - BASIC POST FLIGHT OR THRUFLIGHT INSPECTION
D - PREFLIGHT INSPECTION
E - HOURLY POSTFLIGHT OR MINOR INSPECTION
H - HOME STATION CHECK
J - CALIBRATION OF OPERATIONAL EQUIPMENT
M - INTERIOR REFURBISHMENT
P - PERIODIC, PHASE OR MAJOR INSPECTION
Q - FORWARD SUPPOT SPARES
R - DEPOT MAINTENANCE
S - SPECIAL INSPECTIONS
T - TIME COMPLIANCE TECHNICAL ORDERS
Y - AIRCRAFT TRANSIENT MAINTENANCE

COMPONENT POSITION (CP) - A SINGLE NUMERICAL CHARACTER TO SIGNIFY THE INSTALLED POSITION OF ENGINES AND ASSOCIATED COMPONENTS.

WORK UNIT CODE (WUC) - FIVE CHARACTERS USED TO IDENTIFY THE SYSTEM, SUBSYSTEM, AND COMPONENT ON WHICH WORK IS REQUIRED OR PERFORMED. THE FOLLOWING SHOWS THE BREAKDOWN OF A COMMON AIRCRAFT WUC:

EXAMPLE WUC : 72117 T-39A NAVIGATION RADAR DOPPLER DRIFT AMPLIFIER

72 = RADAR NAVIGATION SYSTEM
721 = AN/APN-131 DOPPLER SUBSYSTEM
72117 = DRIFT AMPLIFIER COMPONENT

LISTED BELOW ARE THE BASIC STANDARD AIRCRAFT SYSTEMS AS INDICATED BY THE FIRST TWO POSITIONS OF THE WUC

01 - GROUND HANDLING, SERVICING, AND RELATED TASKS
02 - ACFT CLEANING
03 - SCHEDULED INSPECTIONS
04 - SPECIAL INSPECTIONS
05 - STORAGE OF EQUIPMENT
06 - ARMING/DISARMING
07 - RECORDS PREPARATION
08 - NOT USED

09 - SHOP SUPPORT
10 - NOT USED
11 - AIRFRAME
12 - COCKPIT AND FUSELAGE COMPARTMENTS
13 - LANDING GEAR
14 - FLIGHT CONTROLS
17 - AERIAL RECOVERY
22 - TURBOPROP POWER PLANT
23 - TURBO-JET ENGINE
24 - AUXILIARY POWER PLANT
32 - HYDRAULIC PROPELLER
41 - AIR CONDITIONING, PRESSURIZATION, AND SURFACE ICE CONTROL
42 - ELECTRICAL POWER SUPPLY
44 - LIGHTING
45 - HYDRAULIC AND PNEUMATIC POWER SUPPLY
46 - FUELS
47 - OXYGEN
49 - MISCELLANEOUS UTILITIES
51 - INSTRUMENTS
52 - AUTOPILOT
55 - MALFUNCTION ANALYSIS AND RECORDING EQUIPMENT
56 - AUTOMATIC ALL WEATHER LANDING
61 - HF COMMUNICATIONS
62 - VHF COMMUNICATIONS
63 - UHF COMMUNICATIONS
64 - INTERPHONE
65 - IDENTIFICATION FRIEND OR FOE
66 - EMERGENCY COMMUNICATIONS
68 - AIR FORCE SATELLITE COMMUNICATIONS
69 - MISCELLANEOUS COMMUNICATIONS EQUIPMENT
71 - RADIO NAVIGATION
72 - RADAR NAVIGATION
73 - BOMBING NAVIGATION
74 - FIRE CONTROL
75 - WEAPONS DELIVERY
76 - ELECTRONIC COUNTERMEASURE
77 - PHOTOGRAPHIC/RECONNISSANCE
82 - COMPUTER AND DATA DISPLAY
89 - AIRBORNE BATTLEFIELD COMMAND CONTROL CENTER
91 - EMERGENCY EQUIPMENT
94 - METEROLOGICAL EQUIPMENT
96 - PERSONNEL AND MISCELLANEOUS EQUIPMENT
97 - EXPLOSIVE DEVICES AND COMPONENTS
98 - ATMOSPHERIC RESEARCH EQUIPMENT

ACTION TAKEN (AT)- ONE CHARACTER USED TO IDENTIFY THE SPECIFIC MAINTENANCE ACTION TAKEN AS LISTED BELOW.

A - BENCH CHECKED AND REPAIRED
B - BENCH CHECKED SERVICEABLE
C - BENCH CHECKED REPAIR DEFERRED
D - BENCH CHECKED TRANSFERRED
E - INITIAL INSTALLATION
F - REPAIR
G - REPAIRS AND/OR REPLACEMENT OF MINOR PARTS, HARDWARE AND SOFTGOODS
H - EQUIPMENT CHECKED NO REPAIR REQUIRED
J - CALIBRATED NO ADJUSTMENT REQUIRED
K - CALIBRATED ADJUSTMENT REQUIRED
L - ADJUST

M - DISASSEMBLE
N - ASSEMBLE
P - REMOVED
Q - INSTALLED
R - REMOVE AND REPLACE
S - REMOVE AND REINSTALL
T - REMOVED FOR CANNIBALIZATION
U - REPLACED AFTER CANNIBALIZATION
V - CLEAN
X - TEST-INSPECT-SERVICE
Y - TROUBLESHOOT
Z - CORROSION REPAIR

NOT REPAIRABLE THIS STATION CODES

1 - REPAIR NOT AUTHORIZED BY SHOP
2 - LACK OF EQUIPMENT, TOOLS, OR FACILITIES
3 - LACK OF TECHNICAL SKILLS
4 - LACK OF PARTS
5 - SHOP BACKLOG
6 - LACK OF TECHNICAL DATA
7 - LACK OF EQUIPMENT, TOOLS, FACILITIES, SKILLS, PARTS OR TECHNICAL DATA
    REPAIR IS AUTHORIZIED BUT THE ABOVE IS NOT AUTHORIZIED
8 - RETURNED TO DEPOT
9 - CONDEMNED

WHEN DISCOVERED (WD) - ONE CHARACTER USED TO IDENTIFY WHEN A DEFECT OR MAINTENANCE REQUIREMENT WAS DISCOVERED, CODES ARE LISTED BELOW.

A - BEFORE FLIGHT ABORT
B - BEFORE FLIGHT NO ABORT
C - IN-FLIGHT ABORT
D - IN-FLIGHT NO ABORT
E - AFTER FLIGHT
F - BETWEEN FLIGHTS BY GROUND CREW
H - THRUFLIGHT INSPECTION
J - PREFLIGHT INSPECTION
K - MINOR INSPECTION
L - DURING TRAINING
M - MAJOR INSPECTION
N - REFURBISH
P - FUNCTIONAL CHECK FLIGHT
Q - SPECIAL INSPECTION
R - QUALITY CONTROL CHECK
S - DEPOT LEVEL MAINTENANCE
T - DURING SCHEDULED CALIBRATION
U - NON-DESTRUCTIVE TESTING
W - IN-SHOP REPAIR AND/OR DISASSEMBLY FOR MAINTENANCE
X - ENGINE TEST STAND OPERATION
Y - UPON RECEIPT OR WITHDRAWAL FROM SUPPLY STOCKS
2 - DURING OPERATION OF MALFUNCTION ANALYSIS AND RECORDING EQUIPMENT
3 - HOME STATION CHECK
4 - BASIC POSTFLIGHT INSPECTION

HOW MALFUNCTION CODE (HM) THIS CODE CONSISTS OF THREE CHARACTERS AND IS USED T IDENTIFY THE NATURE OF THE EQUIPMENT DEFECT, OR THE STATUS OF THE ACTION BEIN ACCOMPLISHED. ONLY THOSE CODES THAT ARE APPLICABLE WILL BE LISTED IN EACH WOR UNIT CODE MANUAL. DUE TO THE NATURE OF SUPPORT GENERAL TYPE WORK, THE RECORDI OF ACTION TAKEN, WHEN DISCOVERED, AND HOW MALFUNCTION CODES IS NOT REQUIRED WI SUPPORT GENERAL WORK UNIT CODES. A COMPLETE LIST OF AUTHORIZED CODES IS

CONTAINED IN AFM 300-4 IN BOTH DEFINITION AND NUMERICAL CODE SEQUENCE.

<u>CATEGORY OF LABOR (CLB)</u> - THIS DATA ELEMENT IS USED TO DIFFERENTIATE THE TYPE OF MAN-HOURS EXPENDED AS LISTED BELOW.

1 - MILITARY REGULAR DUTY HOURS
2 - MILITARY OVERTIME HOURS
3 - FEDERAL SERVICE EMPLOYEE-REGULAR DUTY HOURS
4 - FEDERAL SERVICE EMPLOYEE-OVERTIME HOURS
5 - LOCAL NATIONAL EMPLOYEE HOURS
6 - CONTRACTOR LABOR HOURS

<u>COMMAND/ACTIVITY IDENTIFICATION (CMD/AI)</u> - TWO CHARACTERS USED TO IDENTIFY THE OWNING COMMAND OR MAY BE USED BY THE UNIT TO IDENTIFY SPECIAL PROJECTS, TENANT SUPPORT, OR OTHER ACTIONS. OWNING COMMAND CODES ARE LISTED BELOW:

0A - ALASKAN AIR COMMAND
0B - U.S. AIR FORCE ACADEMY
0C - AEROSPACE DEFENSE COMMAND
0D - U.S. AIR FORCES IN EUROPE
0E - AIR FORCE ACCOUNTING AND FINANCE CENTER
0F - AIR FORCE LOGISTICS COMMAND
0H - AIR FORCE SYSTEMS COMMAND
0I - AIR RESERVE PERSONNEL CENTER
0J - AIR TRAINING COMMAND
0K - AIR UNIVERSITY
0L - USAF SOUTHERN COMMAND
0M - HQ AIR FORCE RESERVE
0N - HEADQUARTERS USAF
0O - AIR FORCE DATA AUTOMATION AGENCY
0P - HEADQUARTERS COMMAND, USAF
0Q - MILITARY AIRLIFT COMMAND
0R - PACIFIC AIR FORCES
0S - STRATEGIC AIR COMMAND
0T - TACTICAL AIR COMMAND
0U - ELECTRONIC SECURITY COMMAND
0Y - AIR FORCE COMMUNICATIONS COMMAND
02 - AIR FORCE INSPECTION AND SAFETY CENTER
03 - AIR FORCE TEST AND EVALUATION CENTER
05 - AIR FORCE INTELLIGENCE SERVICE
06 - AIR FORCE AUDIT AGENCY
07 - AIR FORCE OFFICE OF SPECAIAL INVESTIGATION
09 - AIR FORCE MANPOWER AND PERSONNEL CENTER
1W - AIR FORCE ENGINEERING AND SERVICES AGENCY
1X - AIR FORCE COMMISSARY SERVICE
40 - MILITARY ASSISTANCE COUNTRIES
41 - U.S. READINESS COMMAND
42 - ROYAL CANADIAN AIR FORCE
43 - ROYAL AIR FORCE, UNITED KINGDOM
44 - AIR FORCE TECHNICAL APPLICATIONS CENTER
45 - WEST GERMAN AIR FORCE
46 - OTHER FOREIGN GOVERNMENT
47 - COMMERCIAL AIRCRAFT
48 - SYSTEM SUPPORT MANAGER
49 - DEPARTMENT OF DEFENSE
4A - OTHER USAF ACTIVITIES
4B - FEDERAL AVIATION AGENCY
4C - OTHER U.S. GOVERNMENT

4D - BELGIAN AIR FORCE
4E - ROYAL DANISH AIR FORCE
4F - ROYAL NETHERLANDS AIR FORCE
4G - ROYAL NORWEGIAN AIR FORCE
4I - NATO AWACS PROGRAM
4J - EUROPEAN PARTICIPATING AIR FORCE
4W - MEDICAL MATERIEL FIELD OFFICE
4Z - AIR NATIONAL GUARD

MISSION DESIGN SERIES (MDS) - THIS 7 DIGIT ELEMENT IS THE COMPLETE DESIGNATION FOR AIRCRAFT, MISSILES AND C-E EQUIPMENT.
EXAMPLE: NKC135A

NKC = THE MISSION OF THE AIRCRAFT
135 = THE DESIGN OF THE AIRCRAFT
A = THE SERIES OF THE AIRCRAFT

SERIAL NUMBER (S/N) - THE 8 DIGIT SERIAL NUMBER ASSIGNED TO THE ITEM. FOR ENGINES AND RELATED PARTS THIS NUMBER IS CONTROLLED BY AFM 400-1.

ESTIMATED TIME IN COMMISSION (ETIC) - YEAR, DAY AND HOUR OF ESTIMATED TIME AN ITEM WILL BE RETURNED TO OPERATIONAL STATUS.

UNITS PRODUCED (UP) - PERMITS THE IDENTIFICATION OF COMPLETED MAINTENANCE ASCTIONS; ACTIONS THAT WERE IN PROGRESS BUT NOT COMPLETED; OR ACTIONS IN WHICH WORKCENTER PARTICIPATED BUT WAS NOT THE WORKCENTER ASSIGNED PRIMARY RESPONSIBILITY FOR THE COMPLETION OF THE ACTION.

DATE - YEAR AND DATE OF THE ACTION. EXAMPLE: 4099

STATION LOCATION CODE (SLC) - THIS IS A 4 DIGIT CODE LISTED WITHIN AFM 300-4 FO THE BASE, OPERATING LOCATION, OR SITE AT WHICH THE WORK WAS PERFORMED.

TAG NUMBER (TAG) - THE LAST THREE DIGITS OF THE AFTO FORM 350 TAG NUMBER THAT I PREPARED AND IS TO BE ATTACHED TO THE REMOVED ITEM WHICH WAS IDENTIFIED WITH AN ASTERISK IN THE WORK UNIT CODE MANUAL.

FEDERAL SUPPLY CLASS (FSC) - THE FIRST FOUR DIGITS OF THE NATIONAL STOCK NUMBER OF THE ITEM BEING REMOVED.

PART/LOT NUMBER (P/N) - THE PART NUMBER OF THE ITEM BEING MODIFIED OR REMOVED, INCLUDING SLASHES AND DASHES BETWEEN NUMERICS ONLY. FOR CONVENTIONAL MUNITIONS ITEMS THIS WILL BE THE LOT NUMBER OF THE ITEM. FOR ITEMS THAT DO NOT HAVE PART/LOT NUMBERS, ENTER THE NATIONAL ITEM IDENTIFICATION NUMBER (NIIN) WHICH IS THE LAST NINE CHARACTERS OF THE NATIONAL STOCK NUMBER (NSN).

REFERENCE SYMBOL - THE GRID LOCATION OF AN ITEM ON AN EQUIPMENT WIRING DIAGRAM OR ITS COMMON NAME.

<u>OPERATING TIME</u> - THE HOURS A PIECE OF EQUIPMENT HAS/WILL OPERATE.

<u>FLYING HOURS (F/H)</u> - THE TIME AN AIRCRAFT HAS FLOWN.

SYSTEM CODES

01	Ground Handling, Servicing & Related Tasks
02	Aircraft Cleaning
03	Look Phase of Scheduled Inspections
04	Special Inspections
05	Preservation
06	Arming and Disarming
07	Preparation & Maintenance of Records
09	Shop Support General
11	Airframe
12	Cockpit & Fuselage Compartments
13	Landing Gear
14	Flight Control
15	Helicopter Rotor System
16	Escape Capsule
17	Aerial Recovery System
18	Verticle or Short Takeoff and Landing (V/STOL) Power and Control Transmission System
21	Reciprocating Power Plant

22 Turbo Prop/Turboshaft Power Plant

23 Turbo Jet or Turbo Fan Power Plant

24 Auxilliary Power Plant

25 Rocket Power Plant

26 Helicopter Rotrary Wing Drive System

31 Electric Propeller

32 Hydraulic Propeller

33 Electro Hydraulic Propeller

34 Mechanical and Fixed Pitch Propellers

41 Air Conditioning, Pressurization and Surface Ice Control

42 Electrical Power Supplly

44 Lighting System

45 Hydraulic and Pneumatic Power Supply

46 Fuel System

47 Oxygen System

49 Miscellaneous Utilities

51 Instruments

52 Autopilot

53 Drone Airborne Launch and Guidance Systems

54 Telemetry

55 Malfunction Analysis and Recording Equipment

56 Automatic All Weather Landing System

57 Integrated Guidance and Flight Control - Includes Auto Pilot When Part of Integrated System

61 HF Communications

62 VHF Communications

63 UHF Communications

64 Interphone

65 IFF

66 Emergency Communications

68 AFSAT Communications

69 Miscellaneous Communications Equipment

71 Radio Navigation

72 Radar Navigation

73 Bombing-Navigation

74 Fire Control

75 Weapon Delivery

76 Electronic Countermeasure

77 Photographic/Reconnaissance

81 Airborne Command and Control Surveillance Radar (AWACS)

82 Computer and Data Display (Graphic)

89 Airborne Battlefield Command Control Center (Capsule)

91 Emergency Equipment

92 Tow Target Equipment

93 Drag Chute Equipment

94 Meteorological Equipment

95 Smoke Generator, Scoring and Target Area Augmentation Systems, and Airborne Co-operational Equipment

ADPE RECORD LAYOUT
(120 COLUMNS)

JOB NUMBER	D056E
SYSTEM	Product Performance
TITLE	AFR 66-1 Maintenance Data
TAPE NUMBER	
STANDARD FILE	
[ ] DRUM [X] TAPE [ ] MEMORY [ ] OTHER	
INSTRUCTIONS	
PAGE 1 OF 2 PAGES	

Record	Fields (in column order)
AFR 65-110 Data Record *Lead-The-Force Indicator (Col. 82) L = Lead The Force Blank = All other	MDS (Mission, Design, Series); Command; Base; [X]; Inv.; [X]; Hours Flown; Number of Landings; [X]; Month Code A-L; [X]; Number of Sorties; [X]; Month; Year; [X]; Record Code L; LTF Indicator; [X]
Record Layout No. 1 (On Equipment Aircraft, Missile and JETD C-E)	Aircraft - Missile - C-E JETD (Mission, Design, Series, [X], Serial Number); Time; Perform Work Center; Type Maint; SRD; Year; Day; C P N; Work Unit Code; [X]; Action; Wh Dis; How Mal; Units; [X]; Man Hours Tenths; Start Time; Stop Time; Crew; Base Code; Command; Tag No.; JCN (Day, Seq. No.); Last 4 of ID No.; Record Code A; Type How Mal; Type Equipment; EAD or ACFT MDS
Record Layout No. 2 (On Equipment Engine)	Engine Identity (Type, Model, Series, Modif, Year Mfg, Cod Serial Number); Time; Perform Work Center; Type Maint; SRD; Year; Day; C P N; Work Unit Code; [X]; Action; Wh Dis; How Mal; Units; [X]; Man Hours Tenths; Start Time; Stop Time; Crew; Base Code; Command; Tag No.; JCN (Day, Seq. No.); Last 4 of ID No.; Record Code; Type How Mal; Type Equipment; ACFT MDS
Record Layout No. 3 (On Equipment Non-Airborne)	AGE - Trainers - Weapons - Non-JETD C-E (End Item FSC; Registration Number Serial Number or Part Number); Time; Perform Work Center; Type Maint; SRD; Year; Day; C P N; Work Unit Code; [X]; Action; Wh Dis; How Mal; Units; [X]; Man Hours Tenths; Start Time; Stop Time; Crew; Base Code; Command; Tag No.; JCN (Day, Seq. No.); Last 4 of ID No.; Record Code G; Type How Mal; Type Equipment; EAD
Record Layout No. 4 (Off Equipment)	FSC; Component Part Number; Time or PME Serial Number; Perform Work Center; Type Maint; SRD; Year; Day; C P N; Work Unit Code; [X]; Action; Wh Dis; How Mal; Units; [X]; Man Hours Tenths; Start Time; Stop Time; Crew; Base Code; Command; Tag No.; JCN (Day, Seq. No.); Last 4 of ID No.; Record Code H; Type How Mal; Type Equipment; EAD or MDS
Record Layout No. 5 (Parts Replaced During Repair)	FSC; Bit and Piece Part Number; Bit and Piece WUC; Perform Work Center; Type Maint; SRC; Year; Day; C P N; Work Unit Code; [X]; How Mal; Quantity; Reference Symbol; Base Code; Command; Tag No.; JCN (Day, Seq. No.); Last 4 of ID No.; Record Code P; Type How Mal; Type Equipment; EAD or MDS
Record Layout No. 6 (Summarized Aircraft Support General)	Mission; Design; Series; [X]; Perform Work Center; Type Maint; SRC; Date (Year, Month); Work Unit Code; [X]; Units; [X]; Man Hours (tenths); Base Code; Command; [X]; Record Code S; Type Equipment; MDS

AFLC FORM FEB 66 740A PREVIOUS EDITION OF THIS FORM MAY BE USED

ADPE RECORD LAYOUT (120 COLUMNS)

JOB NUMBER	SYSTEM	TAPE NUMBER		INSTRUCTIONS	PAGE
D056E	Product Performance		☐ DRUM ☐ MEMORY		2 OF 2 PAGES
TITLE: AFR 66-1 Maintenance Data		STANDARD FILE	☒ TAPE ☐ OTHER		

Record Layout	Fields (left to right)
Record Layout No. 7 (Removal of Serialized Components)	FSC · Component Part Number · [X] · Perform Work Center · Type Maint · SRD · Year · Day · CPN · Work Unit Code · Action · Wh Dis · How Mal · Item Serial Number · Remove R · Base Code · Command · Tag No. · JCN (Day, Seq. No.) · Last 4 of ID No. · Record Code R · Type How Mal · Type Equipment · EAD or MDS
Record Layout No. 8 (Installation of Serialized Components)	[X] · Component Part Number · Replace Item Time · Perform Work Center · Type Maint · SRD · Year · Day · CPN · Work Unit Code · Action · [X] · Item Serial Number · Install I · Base Code · Command · Tag No. · JCN (Day, Seq. No.) · Last 4 of ID No. · Record Code R · Type Equipment · EAD or MDS
Record Layout No. 9 (Removal/Installation of Aircraft Engines)	Aircraft Identity (Mission · Design · Series · [X] · Serial Number) · Engine Time · Perform Work Center · Type Maint · SRD · Year · Day · CPN · Engine Identity (Type · Model · Series · Modif · Year · Serial Number) · R/I · Base Code · Command · Tag No. · JCN (Day, Seq. No.) · Last 4 of ID No. · Record Code T · Type Equipment · ACFT MDS
Record Layout No. 10 (Aircraft, Missile, and JETD C-E TCTO Data)	Aircraft - Missile - JETD C-E (Mission · Design · Series · [X] · Serial Number) · Time · Perform Work Center · Type Maint T · SRD · Year · Day · CPN · TCTO Data Code · How Mal · Units · Man Hours Tenths (Start Time · Stop Time) · Crew · Base Code · Command · Tag No. · JCN (Day, Seq. No.) · Last 4 of ID No. · Record Code A · Type Equipment · EAD or MDS
Record Layout No. 11 (Engine TCTO Data)	Engine Identity (Type · Model · Series · Modif · Year or Mfg. Code · Serial Number) · Time · Type Maint T · SRD · Year · Day · CPN · TCTO Data Code · How Mal · Units · Man Hours Tenths (Start Time · Stop Time) · Crew · Base Code · Command · Tag No. · JCN (Day, Seq. No.) · Last 4 of ID No. · Record Code E · Type Equipment · ACFT MDS
Record Layout No. 12 (Non-Airborne TCTO Data)	AGE - Trainers - Weapons - NON-JETD C-E (End Item WUC · Registration Number Serial Number or Part Number) · Time · Perform Work Center · Type Maint. T · SRD · Year · Day · CPN · TCTO Data Code · How Mal · Units · Man Hours Tenths (Start Time · Stop Time) · Crew · Base Code · Command · Tag No. · JCN (Day, Seq. No.) · Last 4 of ID No. · Record Code G · Type Equipment · EAD
Record Layout No. 13 (Off Equipment TCTO Data)	FSC · Component Part Number · Time · Perform Work Center · Type Maint. T · SRD · Year · Day · CPN · TCTO Data Code · How Mal · Units · Man Hours Tenths (Start Time · Stop Time) · Crew · Base Code · Command · Item Serial No. · Last 4 of ID No. · Record Code H · Type Equipment · EAD or MDS

AFLC FORM 740A PREVIOUS EDITION OF THIS FORM MAY BE USED.

B4 MASTER RECORD

1-2	TYPE CARD (B4)
3-4	LEAVE BLANK
5	TYPE EQUIPMENT (A, B, G, M, N, T, W)
6	MANAGEMENT ALC
7-13	END ARTICLE DESIGNATOR (EAD)
14-18	WORK UNIT CODE (WUC)
19-37	WUC DISCRIPTION
38	CATEGORY INDICATOR
39-42	FAILURE LIMIT (NON-AIRBORNE)
43-45	QUANITY PER APPLICATION (QPA)
46-49	INVENTORY (SPECIAL OR NON-AIRBORNE)
50	BLANK
51-57	INSPECTION REQUIREMENT (DASH 6 SECTIONS)
58-62	REPLACEMENT INTERVAL
63	REPLACEMENT CATEGORY
64-69	ACTION LIMIT (AIRBORNE ONLY)
70-73	USE FACTOR
74	NRTS INDICATOR
75-79	BLANK
80	TRANSACTION INDICATOR (A OR C)

ATTACHMENT V

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